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Rural-urban social accounting matrixes for modelling the impact of rural development policies in the EU

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Abstract

This report complements previous work and builds NUTS3 SAMs for twelve regions, following a careful approach, that we call the expert approach. This report investigates the results of this approach by running some simple policy simulations and providing the structural descriptions of these regions. Further, this report aims at producing testing a more automatic approach to the construction of NUTS3 SAMs, to a view of reducing the necessary time and data requirements. Using several examples, this report examines whether such automatic approach can provide reliable SAMs at NUTS3 level. It finally draws conclusions as to the usefulness of both approaches in providing tools for further policy analysis in the field of rural development policy analysis

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[1] CLIMAMODEL SEJ-511 is a Research Group located at Pablo de Olavide University, Seville (Spain) and registered at the Regional Government Junta de Andalucía (Spain). The group has been working for more than fifteen years in multi-sectoral models applied to public policies, environmental issues and producing social accounting matrices and databases.

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Acronyms

BL	Backward Linkage
CAP	Common Agricultural Policy
CEM	Cross Entropy Method
CGE	Computable General Equilibrium
CRAS	Cell corrected RAS method
DGURBA	Degree of Urbanisation
EAA	European Agricultural Accounts
EAFG	European Agricultural Fund for Guarantee
EAFRD	European Agricultural Fund for Rural Development
ERAS	Extended RAS method
ESU	Economic Size Unit
FL	Forward Linkage
GDP	Gross Domestic Product
GRAS	Generalised RAS method
IOT	Input Output Table
IPTS	Institute for Prospective Technological Studies
JRC	Joint Research Centre
KRAS	Konfliktfreies RAS method
LAU	Local Administrative Units
MoRE	Modelling Rural Economies
MPM	Multiplier Product Matrix
MRAS	Modified RAS method
NACE	Statistical Classification of Economic Activities in the European Community
NPISH	Non-Profit Institutions Serving Households
NUTS	Nomenclature of Units for Territorial Statistics
RD	Rural Development
SAM	Social Accounting Matrix
SimSIP SAM	Simulations for Social Indicators and Poverty using Social Accounting Matrices
SIOT	Symmetric Input Output Table
SUT	Supply and Use Tables
SUT-RAS	Supply-Use Table RAS method
TRAS	Third stage RAS method

1 Introduction

The Rural Development Policy, often referred as Pillar 2, has become along the 90s a significant element of the Common Agricultural Policy, its importance has been confirmed by the latest reforms of the Common Agricultural Policy. It represents in terms of budget close to one third of the total CAP budget. Before integration of flexibility between pillars and other adjustment, the amounts dedicated to rural development policies over the financial period 2014-2020 are likely to reach 95 billion euros on a total of 348 billion euros for both pillars of the CAP (27% of the total). In recent years, several research programmes, scientific papers and policy reports have looked at ways to assess the impacts of Pillar 2 at country and regional levels. The European Commission and the Member States carries pout periodic ex ante, mid-term and ex post evaluation of the rural development policy and of the Rural Development Programmes. Several FP7 and/or Horizon 2020 research programmes are dedicated to the evaluation of the impact of rural development policies, such as CAPRI-RD, SPARD, RUDI, etc.

Because rural development policies do not only aim at supporting specific sectors (such as agriculture), many studies have used Computable General Equilibrium (CGE) models in order to capture the full economy impact. Several measures are focusing non-farm actors, such as a whole set of measures in favour of forestry and its downstream industries, as well as the measures referring the improvement of quality of life in rural areas (where diversification from agriculture and forestry is favoured, e.g. in tourism or energy production, as well as public investment in rural heritage or infrastructures) and the participatory programmes LEADER. Those CGE models rely on the use of Social Accounting Matrixes (SAM). Given the nature of rural development (regional implementation through Rural Development Programmes and existence of menus offered to the beneficiaries in each region), the need for modelling at sub-regional level has led to the application of these models at NUTS3 level (see RURAL ECMOD), with models going as deep as modelling the rural part and urban part of NUTS3 regions. The challenge of such work is that it requires extensive work in the construction of NUTS3 SAMs, especially if the rural-urban split is modelled.

Given that background, this report complements previous work (see RURAL ECMOD) and builds NUTS3 SAMs for twelve regions, following a careful approach, that we call the expert approach. This report investigates the results of this approach by running some simple policy simulations and providing the structural descriptions of these regions. Further, this report aims at testing a more automatic approach to the construction of NUTS3 SAMs, in view of reducing the necessary time and data requirements. Using several examples, this report examines whether such automatic approach can provide reliable SAMs at NUTS3 level. It finally draws conclusions as to the usefulness of both approaches in providing tools for further policy analysis in the field of rural development policy analysis

2 Data availability and collection

In this section, available data for each region is presented and a procedure for regionalising Supply and Use tables is developed.

2.1 Data availability

In a first step, the objective is to construct twelve rural-urban ('rurban') NUTS3 SAMs, using the full set of statistical (Input Output Tables – IOT – or existing SAM material from national and/or regional official statistical offices) and expert information locally available. The regions are chosen following a cluster classification of European NUTS3 regions (i.e. Raggi et al., 2013), after discussion taking in to account the data availability.

The following clusters are distinguished: Cluster 1 includes provinces classified as intermediate urban/rural, economically diversified, with high accessibility and high gross domestic product (GDP). Cluster 2 contains rural provinces agriculturally dependent, with good accessibility and high GDP. Cluster 3 takes into account NUTS3 predominantly rural and agriculture dependent, with low accessibility and low GDP. Cluster 5 contains rural NUTS3, strongly economically dependent from agriculture with the lowest accessibility index and low GDP. Finally, Cluster 6 consists of urban and intermediate provinces with low GDP, intermediate accessibility and intermediate economic diversification.

The list of regions and clusters are presented below:

Table 1 – NUTS3 regions and clusters' classification.

	EU CODE	NAME	CLUSTER
1	DE935	Lüneburg	1
2	UKH13	Norfolk	1
3	DE138	Konstanz	1
4	SI022	Gorejnska	2
5	SE124	Örebro	2
6	HU312	Heves	3
7	EE004	Lääne-Eesti	3
8	ES241	Huesca	5
9	PT172	Península de Setúbal	6
10	PL631	Słupski	3
11	NL131	Noord Drenthe	2
12	FR522	Finistère	2

Source: Own elaboration.

The research team has contacted data providers from different countries and statistical offices and institutions to obtain the data necessary for each of the case studies. In the next table, we present contact details for the corresponding institution:

Table 2 - List of countries, data providers and institutions.

Country	Partner	Institution
UK	Sanjiv Mahajan	National Statistical Office http://www.ons.gov.uk/
DE	Frank Thalheimer	Regional Accounts Volkswirtschaftliche Gesamtrechnungen der Länder VGRdL http://www.vgrdl.de
SI	Janja Kalin	National Statistical Office http://www.stat.si
ES	Alfredo Mainar	University of Saragossa http://www.unizar.es
HU	Maria Forgon	National Statistical Office http://www.ksh.hu/
NL	Rutger Hoeskstra	National Statistical Office http://www.cbs.nl/
FR	Chantal Brutel	National Statistical Office http://www.insee.fr/
PL	H. Gembarzewska	National Statistical Office http://www.stat.gov.pl/
PT	Cristina Ramos	National Statistical Office http://www.ine.pt/
SE	Johanna Erkelius	National Statistical Office http://www.scb.se/
EE	Iljen Dedegkajeva	National Statistical Office http://www.stat.ee/

Source: Own elaboration.

After contacting Statistical Offices and researchers from different countries and institutions, the statistical information necessary to run the EURO method (described and discussed in the subsequent section 2.2.1) for regionalising Supply and Use Tables (SUT) has been obtained for each country. This information is presented in the following tables:

Table 3 - Statistical information at NUTS 3 level after contacts.

NUTS III	1	1	2	1	1	1	1	1	1	1	1	12
	ES	**FR**	**DE**	**NL**	**PT**	**UK**	**PL**	**HU**	**SI**	**SE**	**EE**	
1. Use tables at basic prices and/or purchaser's prices												0
2. Supply table at basic prices with a transformation into purchaser's prices												0
3. Input-Output Table at basic prices	X											0
4. GDP	X	X	X	X	X		X	X	X	X	X	9
5. Gross value added by industry		X	X	X	X	X	X	X	X		X	9
6. Gross wages and salaries by industry		X	X	X	X	X		X		X		7
7. Total consumption of households (broken down by products if available)												0
8. Total consumption of government (broken down by products if available)												0
9. Total consumption of NPISH (non-profit institutions serving households) (broken down by products if available)												0
10. Total gross capital formation (broken down by products if available)				X								1
11. Total exports (broken down by products if available)	X											0
12. Total taxes less subsidies on products (broken down by products if available)				X								1
13. Total imports (broken down by products if available)	X											0
14. Total employment by industry	X	X	X		X	X			X	X		6
15. Total number of hours worked by industry			X		X	X	X					4
		4	5	5	5	4	3	3	3	3	2	

Source: Own elaboration.

Table 4 - Statistical information at NUTS 2 level after contacts.

NUTS II	1	1	2	1	1	1	1	1	1	1	1	12
	ES	**FR**	**DE**	**NL**	**PT**	**UK**	**PL**	**HU**	**SI**	**SE**	**EE**	
1. Use tables at basic prices and/or purchaser's prices	X											0
2. Supply table at basic prices with a transformation into purchaser's prices	X											0
3. Input-Output Table at basic prices	X											0
4. GDP	X	X	X	X	X		X	X	X	X	X	9
5. Gross value added by industry	X	X	X	X	X	X	X	X	X		X	9
6. Gross wages and salaries by industry	X	X	X	X	X	X	X	X	X	X	X	10
7. Total consumption of households (broken down by products if available)	X											0
8. Total consumption of government (broken down by products if available)	X											0
9. Total consumption of NPISH (non-profit institutions serving households) (broken down by products if available)	X											0
10. Total gross capital formation (broken down by products if available)	X		X	X	X	X		X	X		X	7
11. Total exports (broken down by products if available)	X											0
12. Total taxes less subsidies on products (broken down by products if available)	X			X								1
13. Total imports (broken down by products if available)	X											0
14. Total employment by industry	X	X	X		X	X	X	X	X	X	X	9
15. Total number of hours worked by industry					X	X	X	X	X		X	6
		6	5	5	6	5	5	6	6	3	6	

Source: Own elaboration

2.2 SAMs at NUTS3 level

SAMs are datasets comprising economic transactions that allow to extract information on the different economic agents such as producers, consumers, the government and the foreign sector, as well as on the behaviour of productive factors and institutions. They complete the information provided by the input-output analysis.

The interest of SAMs is based on the fact that they illustrate the production relationships between the economic sectors as well as the transactions that take place among the different institutions of a certain economic system in terms of revenues or expenses. Besides their statistical interest, which enables us to close the circular flow of income, the SAMs have become a useful tool for evaluation of policy interventions in national or regional frameworks.

Moreover, it is possible to carry out a complete analysis of the productive structure of the economy and to obtain a general perspective of changes that might occur in case of any shock (e.g. key sectors). Below, we present the approach used for obtaining 12 NUTS3 regions SAMs. The estimates of the NUTS3 SAMs are obtained using a two-step process:

1) Input-output frameworks are regionalised (i.e. Supply, Use and Symmetric tables) from the NUTS 1 or countries concerned, using the EURO method (Beutel, 2002, 2008 and Eurostat, 2008).

2) We finalise the NUTS3 SAM estimation using the SUT and some additional information.

2.2.1 The EURO method for regionalising Supply and Use Tables

2.2.1.1 Background

The general balancing problem of matrices basically consists of knowing one single base table (be they SUTs, SIOTs and/or SAMs) and at least the row and column totals for the unknown table that has to be estimated[2]. There are two different ways to approach this under-determined problem where unknowns (e.g. elements of the interior tables) outnumber external constraints:

- in the form of row and column totals[3], e.g. the RAS[4] or bi-proportional scaling methods;
- the constrained optimisation methods (Lenzen et al., 2009).

The RAS[5] method was first described by Stone (1961), Stone and Brown (1962) and used extensively by Bacharach (1970) to update a given input-output table to a more recent or even future period for which only the row and column totals are given (Mínguez et al., 2009). The basic idea of RAS was firstly developed to be used with input-output tables and particularly, with the intermediate inputs matrix. It consists in changing the structure of the known base table as little as possible (Bacharach, 1970). Similarly, Hewings (1969, 1977)

[2] Mínguez et al (2009) and Oosterhaven et al (2011) consider several known tables as base tables but the lack of information at NUTS3 level makes this analysis inappropriate for our purpose.

[3] Other types of arbitrarily sized and shaped subsets of constraints can also be added to the fixed row and column sums, such as in Lenzen et al (2009), Gilchrist and St. Louis (1999) and Paelinck and Waelbroeck (1963). However, though it has been proved that the use of additional partial information improves the accuracy of projections; this is inapplicable here due to the little available information at the NUTS3 level.

[4] In the original presentation of this method (i.e. working paper), the vector of row multipliers was designated by r, the table of inter-industry transactions in coefficient form in the base year by A and the vector of column multipliers by s. Hence the juxtaposition of the notation led to the nomenclature RAS.

[5] The RAS method dates back to the 1930s according to Bregman (1967), who attributes it to the Leningrad architect Sheleikhovskii. However, it was not until Leontief (1941) and, explicitly, Stone (1961) when the RAS method was applied to National Accounts and Input-Output Tables.

used bi-proportional techniques to the problem of regionalizing a national input-output table knowing some row and column totals at the regional level. Later on, Oosterhaven et al. (1986) combined both ideas to solve the problem of updating interregional input-output tables. In addition, there is an extensive literature on several improved versions of the RAS method: GRAS (Generalised RAS - Junius and Oosterhaven, 2003; Lenzen et al. 2007; Temurshoev et al., 2013); TRAS (Third stage RAS - Gilchrist and St.Louis, 1999, 2004); ERAS (Israilevich, 1986); MRAS (Modified RAS - Paelinck and Waelbroecj, 1963); CRAS (Cell Corrected RAS - Mínguez et al., 2009 and Oosterhaven et al., 2011); and KRAS (Konfliktfreies RAS - Lenzen et al., 2009). On the other hand, constrained optimisation methods have also been used prominently in the literature for updating input-output tables (e.g. Stone et al., 1942; Harrigan and Buchanan, 1984; and Tarancón and del Río, 2005).

However, none of the two types of methods have been applied to the context of SUTs; they have been focused on SIOTs and/or direct technical coefficients instead (with the exception of Dalgaard and Gysting, 2004). But probably the most important challenge to use any of them is that they require the row sums of SUTs to be known (e.g. commodity output).

To circumvent this issue, there are one-sided RAS-type methods (e.g. EUKLEMS method, see Temurshoev et al., 2011) or the SUT-RAS method (Temurshoev and Timmer, 2011) that could have been used here when only industry outputs (column sums) are known. But similarly to our earlier argumentation, since information on industry output is not available at the NUTS3 level either in terms of value added by industry or GDP, another approach is followed in this report.

Ultimately, the EURO method is used here as a way to estimate SUTs and SIOTs with the minimum amount of information possible. Actually, this is the only existing method that allows the estimation of SUTs and SIOTs without given row and column totals. The EURO method typically aims at updating SIOTs at basic prices from one year to another and it is based on a previous version initially developed by Beutel (2002) for Input-Output Tables and further explained by the Eurostat Manual of Supply, Use and Input-Output Tables (2008, Ch. 14).

The EURO method is a robust update procedure with low cost and limited data requirements. It exclusively uses official data and integrates all quadrants of SIOTs. Row and column totals for intermediate consumption and output and the corresponding final demand structure are derived endogenously, not allowing for arbitrary changes of input-output coefficients. The method is fully consistent with supply and demand through the Leontief quantity model (Eurostat, 2008). Therefore, it is sustained on economic grounds rather than on optimisation and/or pure mathematical techniques.

Recently, Temurshoev et al. (2011) formalise a SUTs variant of the Euro method based on Beutel (2008). Beutel and Rueda-Cantuche (2012) further elaborate a more detailed version to be used in practice by Eurostat. Yet, in line with the pioneering works of Hewings (1969, 1977), we formulate an adapted version of the latter to be used in this project for the regionalisation of supply and use tables.

2.2.1.2 The EURO method

As a novelty, the EURO method is used in this project as a method for regionalisation. In what follows, we present an adapted and more detailed explanation of the EURO method for SUTs regionalisation mostly based on Temurshoev et al. (2011) description of the EURO method for updating SUTs.

The initial SUTs (typically at the NUTS1 or NUTS2 levels) consist of the following components all expressed at basic prices:

a) Domestic and imported intermediate use matrices (commodity × industry),

b) Domestic and imported final demand matrices (commodity × category of final use),

c) Supply matrix (commodity × industry),

d) Vector of total value added of industries (industry × 1)

e) Vector of total taxes less subsidies on products by industries and final use categories

The projected SUTs require the following macroeconomic statistics for the SUTs at the NUTS3 level, based on regionalisation rates[6] of macroeconomic variables of:

i. value added by industry;

ii. total final demand by use;

iii. total taxes less subsidies on products;

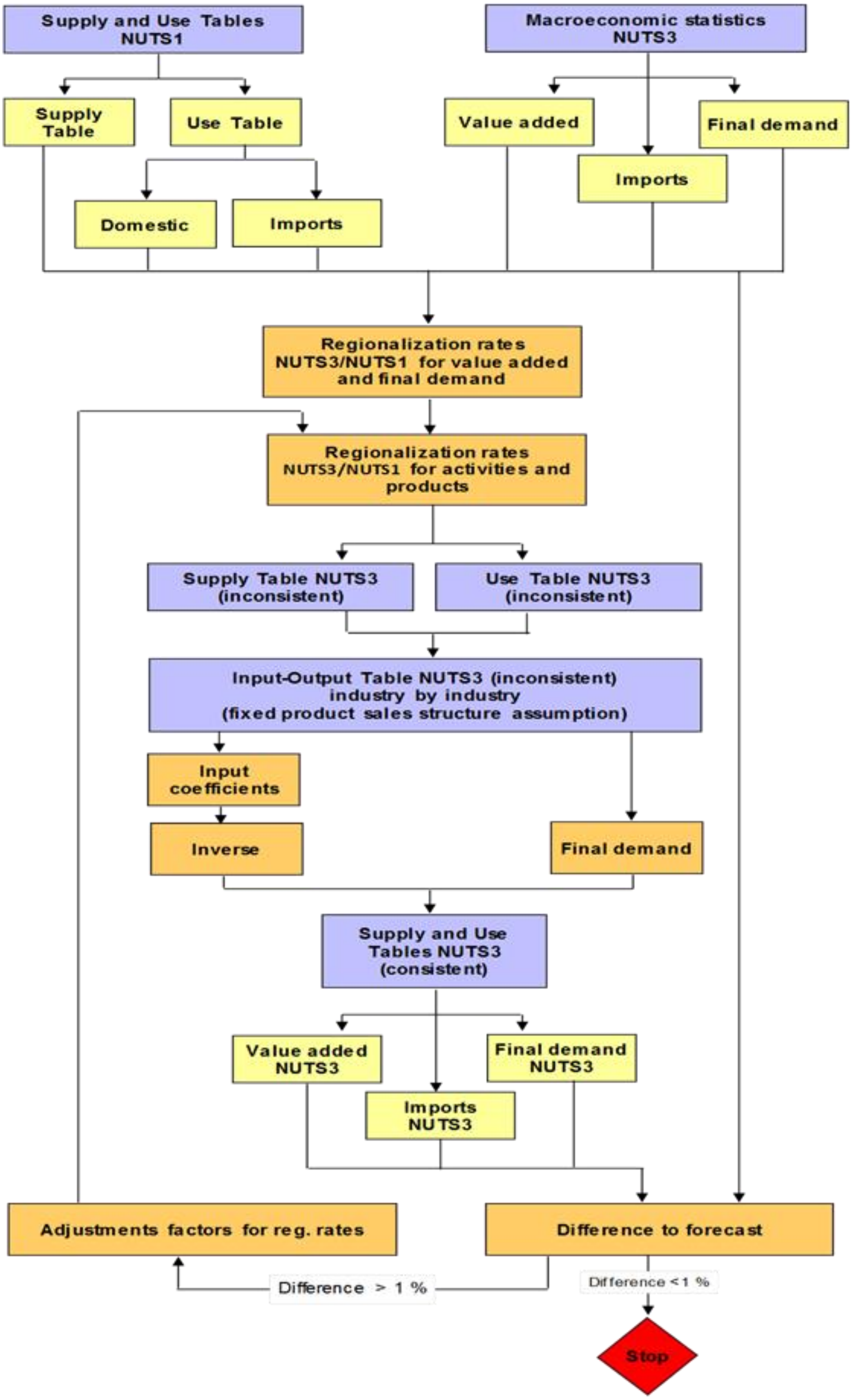
iv. total imports.

The listed data requirements mean that the vectors of value added per industry, totals of final demand categories and aggregate values of taxes less subsidies on products and imports need to be known at the NUTS3 level, too.

Following Thissen et al. (2010), we have used information on interregional transport flows to estimate regional imports and exports. We have used the Eurostat data on road freight transport loading (exports) and unloading (imports) in physical terms and have calculated a ratio over the whole country (in physical terms). The method uses these official statistics as exogenous inputs, and replicates them in the derived SUTs. This method involves minimum data requirements, which is appropriate given the lack of macroeconomic data at NUTS3 level.

[6] They are calculated as regional/national ratios.

Figure 1 – EURO method for regionalising SUTs



Source: Own elaboration based on Beutel and Rueda-Cantuche (2012).

Each of the iterations of the EURO method consists of two steps. The first step of the first iteration defines domestic and imported intermediate and final uses, the vector of value added, the vector of taxes less subsidies on products, and the supply matrix of the projected SUTs. This first estimation of the (unbalanced) use table is basically a cell-wise arithmetic average resulting from multiplying the corresponding regionalisation rates to the rows and columns of the initial use table. Subsequently, the total commodity output (from the estimated use table) is allocated row-wise proportionally to the initial supply table (i.e. constant market shares) in order to obtain the first estimation of the supply table at NUTS3 level. The total industry outputs and inputs are not equal after this first step (column sums of projected supply and use tables). To make the derived SUTs consistent, it is assumed that the domestic and imported input structures of industries and the totals of commodities' final uses from the first step are valid. Given this assumption, the so-called fixed commodity sales structure model determines consistent industry output and input levels (Eurostat, 2008, Model D, p. 351). This second step ensures consistency of the industry outputs and inputs, and commodity supply and demand but however, it deviates from macroeconomic statistics, i.e. value added per industry, final uses of categories, total value added and total imports.

The regionalisation rates initially used are then adjusted in an iterative procedure in order to make the difference between the actual and projected (in each of the iterations) regionalisation rates minimal (less than 1%). The observed deviations are used to correct these rates in such a way that it should ensure that if the model overestimates (underestimates) the available macroeconomic statistics, the corresponding regionalisation rates are decreased (increased). This is done through correction factors (see Eurostat, 2008). Then, the first step of the second iteration computes the projected SUTs components as in the first iteration, i.e. domestic and imported intermediate and final uses, the vector of value added, the vector of taxes less subsidies on products, and the supply matrix of the projected SUTs. As was the case with the first step of the first iteration, the results do not ensure the equality of industry outputs and inputs. The consistent industry outputs and inputs are again found using the fixed commodity sales structure model, which is then used to derive the consistent SUTs of the second iteration in exactly the same manner as defined earlier for the first iteration. However, note that now the domestic and imported input structure matrices are derived from the outcomes of the first step of the second iteration. As a result, one obtains a new deviation vector, which quantifies the difference of the projected regionalisation rates from the macroeconomic statistics. If the difference between the actual and projected regionalisation rates is acceptable, the resulting SUTs are the final outcome of the EURO projection. Otherwise, the steps of the second iteration are repeated until the projected variables resemble (closely or perfectly) those of the macroeconomic statistics. It is important to note that each such subsequent iteration begins with computing new correction factors, which are then used to correct the regionalisation rates from the previous iteration. The convergence in the Euro method can always be found by changing the tolerance level until convergence is reached. The last important point concerning the EURO method is that it requires that the number of industries and commodities have to be equal. Thus, even if the EURO method distinguishes between products and industries, it does not allow for rectangular SUTs estimation[7].

2.2.2 Data Sources and application to NUTS3 case studies

The data requirements of the EURO method are the following for the NUTS3 case studies:

a) Gross value added by industry;
b) Taxes less subsidies on products (total);
c) Final demand components (totals), including exports;
d) Total imports.

The following sections explain the data sources and methods used in the calculation of the necessary data for the projections.

2.2.2.1 Gross value added by industry

It is not very common or easy to find detailed data on gross value added by industry at NUTS3 level. In this project, we will use a breakdown of 6 products/sectors (see below), which will be split up to 13 products/sectors according to the NUTS1 or NUTS2 shares, depending on the available information (see below for the details about the 13 products/sectors).

List of products/sectors from original data source:

1. Agriculture, forestry and fishing
2. Manufacturing industry
3. Construction
4. Trade, transport and telecommunications
5. Finance, renting and business services
6. Public services and other services

List of products/sectors of the MORE Project:

1. Agriculture[8]
2. Forestry
3. Fishing
4. Mining
5. Food and beverages
6. Other manufacturing activities
7. Utilities
8. Construction
9. Trade
10. Hotels and restaurants
11. Transport and telecommunications
12. Other private services

[7] In this project, the EURO method is programmed in the Eviews software and Excel templates are used to accommodate the results to the Eurostat standard format.

[8] This industry still needs further split into arable crops, permanent crops and other agricultural products.

13. Public services

2.2.2.2 Taxes less subsidies on products (total)

Provided that GDP is available for NUTS3 regions, its difference with respect to the total sum of gross value added at basic prices (also available) makes the overall total of taxes less subsidies on products.

2.2.2.3 Final demand components and imports

Gross Domestic Product (GDP) is defined as the sum of: final consumption of households; final consumption of government and non-profit institutions serving households; gross capital formation (investment) and net exports (exports minus imports).

Therefore, by using such definition of GDP, we split up the value of GDP for NUTS3 regions using the shares of GDP's components from the NUTS2 or NUTS1 regions (wherever available). As an example (see Table 6), the Baden-Württemberg (NUTS2) shares of GDP's components are given below as well as the GDP of Konstanz (NUTS3) for 2007 and the corresponding calculation of its final demand total by category.

However, we are interested in calculating exports and imports separately and not as net exports. In order to do so, we estimate NUTS3 exports and NUTS3 imports according to the NUTS3/NUTS1 share of the Eurostat data on road freight transport loading (exports) and unloading (imports). As a result, in a second step, net exports are re-calculated and the other final demand components adjusted accordingly.

Table 5 - Final demand.

	Baden-Württemberg	**Konstanz**
	Share of GDP´s final demand components	Values (Mio. €)
Consumption of households	54.4%	4,328.71
Consumption of Public Administration and Non Profit Institutions Serving Households	15.3%	1,221.22
Gross capital formation	18.4%	1,463.84
Net exports	11.9%	947.91
GDP	**100%**	**7,961.68**

Source: Own elaboration

2.2.3 Construction of NUTS3 Social Accounting Matrices

For the construction of NUTS3 SAMs, we initially develop a basic SAM information linking the input-output framework previously estimated closing economic flows between productive sectors, commodities and institutional sectors. To do this, we use additional information, most of it from Eurostat in order to achieve greater uniformity in the estimation of the matrices for all NUTS3 analysed. However, when more specific information is necessary, we obtain it from local or national statistical offices. The basic sources used are:

- Allocation of primary and secondary income account of households by NUTS1 and NUTS2 regions. (e. g. Baden-Württemberg/Freiburg-Konstanz). Eurostat.
- Income of households by NUTS2 regions (e.g. Freiburg-Konstanz). Eurostat.
- Compensation of employees by NUTS2 regions (e.g. Freiburg-Konstanz). Eurostat.
- Employment by NUTS3 regions. Eurostat.
- Non-financial transactions (e.g. Germany-Konstanz). Eurostat.
- Gross domestic product (GDP) at current market prices by NUTS3 regions. Eurostat.
- Gross value added at basic prices by NUTS3 regions (NACE_R1). Eurostat.
- Disposable income of households. National statistical offices (e.g. Konstanz: VGR der Länder: Regionaldatenbank Deutschland).
- Input-Output tables at NUTS1 or country level (e.g. Germany 2005. Eurostat and OECD).

This information is incorporated into the provided input-output framework, obtaining a first version of the matrix for each NUTS3. Small discrepancies that may arise in the estimation process are corrected by using a simple technical adjustment through RAS. The result is a NUTS3 level basic SAM composed by the following accounts:

Table 6 - NUTS3 SAM accounts.

• A.0-1	Agriculture, hunting and related services
• A.0-2	Forestry, logging and related services
• A.0-3	Fish
• A.0-4	Mining
• A.0-5	Food industries
• A.0-6	Other manufacturing
• A.0-7	Utilities
• A.0-8	Construction
• A.0-9	Trade
• A.0-10	Hotels and restaurants
• A.0-11	Transport and communication
• A.0-12	Other private services
• A.0-13	Public services
• C.0-1	Products of agriculture, hunting and related services
• C.0-2	Products of forestry, logging and related services
• C.0-3	Fish
• C.0-4	Mining
• C.0-5	Food industries
• C.0-6	Other manufacturing
• C.0-7	Utilities

• C.0-8	Construction
• C.0-9	Trade
• C.0-10	Hotels and restaurants
• C.0-11	Transport and communication
• C.0-12	Other private services
• C.0-13	Public services
• L	Labour
• K	Capital
• ANT	Activity net taxes
• CNT	Commodity net taxes
• INT	Income net taxes
• H	Households
• E	Enterprises
• G	Government
• IS	I-S
• ROW	Rest of the World

The only exception in this initial procedure is the SAM for Huesca (Aragon, Spain), that comes from a previous experts version for 2005 and that has simply been updated to 2007 using basic information from Eurostat and RAS adjustment.

Basic SAMs for each NUTS3 can be extended to successively incorporate accounts and sectors needed to perform the required analysis of the corresponding regions. For this, the basic SAM accounts are disaggregated by block, using new information, almost entirely from Eurostat to achieve the greatest possible homogeneity:

- Farmland: number of farms and areas by economic size of farm (ESU) and NUTS2 regions [ef_lu_ovcropesu].
- Agricultural accounts according to EAA 97 Rev.1.1 by NUTS2 regions [agr_r_accts].
- Mean annual earnings by economic activity, sex, occupation [earn_ses06_49]. Countries level.
- Employment by occupation and economic activity [lfsa_eisn2]. Countries level.
- Structure of consumption expenditure by degree of urbanisation (COICOP level 2) (1 000) [hbs_str_t226]. Countries level.
- Mean consumption expenditure by degree of urbanisation (in PPS) [hbs_exp_t136]. Countries level.
- Household characteristics by urbanisation degree [hbs_car_t315]. Countries level..
- Population in Rural Areas (NUTS2-3 level). Eurostat Regional Statistics. Rural Development Indicators.
- Employment (in persons) by rural/urban typology. NACE R1. [urt_e3empl95]. Countries level.
- Gross value added at basic prices NACE R1 [urt_e3vabp95]. Countries level.

Here it is necessary to specify the information required to distinguish between rural and urban activities. The first ones are those developed in rural areas, while the latter are those that are based in urban areas.

To distinguish between urban and rural areas, we take as a reference the database DGURBA2011[9] which provides information on new classification of urbanisation[10]. The LAU2 types 1 or 3 are directly classified as urban or rural, respectively, while type 2 are classified using a threshold of 30,000 inhabitants (below this threshold will be rural and when above, it will be classified as urban). This typology allows fitting the objectives of the study to better distinguish between cases within 'intermediate' areas.

It is very difficult to obtain aggregated and homogeneous accurate information for this split for all cases. We therefore have used an estimate based on a private database from companies at the highest level of geographical disaggregation. Here we use Orbis (by Bureau van Dijk). This database distinguishes number of businesses by industry (NACE R1-R2) at the equivalent of LAU2 level or similar. We have completed the necessary information base with LAU2 demographic data and other Eurostat's official statistics of predominantly rural, intermediate and predominantly urban areas.

With this data, the percentages of companies in rural and urban areas in each sector in each NUTS3 are obtained, which allows the disaggregation between rural and urban sectors in the corresponding SAMs. This disaggregation based on the number of companies shows an adequate representation of the economic reality of each region.

With all this statistical information the percentage representing economic activities in rural and urban areas for each sector can be identified each NUTS3 region. This disaggregation criterion considers that companies that have its head office in a LAU2 (or similar) regarded as Rural (Urban) are entirely allocated to the "rural" part ("urban") of the corresponding NUTS3 region. This creates a division between rural and urban activities within each sector and NUTS3. Obviously, economic activities in intermediate areas are classified as rural or urban based on the previous decision on the allocation of their place of establishment.

For the distinction between large and small farms, we have used data on the number of farms and areas by economic size of farm (ESU) and NUTS2 regions and Agricultural accounts According to EAA 97 Rev.1.1 by NUTS2 regions, both available from Eurostat. The threshold of 16 ESU is used to distinguish between large and small farms for all regions. While we acknowledge that such assumption may lead to inaccuracies in the description of farm sectors across the EU, it is necessary to protect some strong degree of data homogeneity.

Regarding the SAM estimations, we must also take into account that the time periods for which we have additional statistical information do not always coincide with the reference year (2007). In such cases, the nearest periods have been taken and we have always worked using ratios because they are more stable than absolute values.

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[9] http://ec.europa.eu/eurostat/ramon/miscellaneous/index.cfm?TargetURL=DSP_DEGURBA

[10] The classification we use is: 1: densely populated (urban); 2: Intermediate (small towns and suburbs) and 3: sparsely populated (rural). We also use population at level LAU2 (completed with data from national statistical offices).

Next, once accounts are disaggregated, we apply the Cross Entropy Method to achieve the final adjustment for the final version of the SAMs at NUTS3 level. The Cross Entropy Method (CEM) was published by Robinson et al. (2001). In comparison with RAS estimation method, CEM is more flexible, cost-efficient and consistent with all the information provided by national accounts and other resources. This method has been extensively used in the literature and can also consider relationships to be incorporated into the estimation model as additional restrictions[11].

Finally, it is necessary to stress that, since one of the objectives of this work is building an automatic procedure for estimating NUTS3 level SAMs from for NUTS2 or NUTS1 SAMs, the final structure of the SAM accounts should be unique and wide enough to collect specific circumstances of a particular regional economy. That is why we leave in the SAMs accounts such as Agriculture or Forestry in urban areas (see Table 7), which in ad-hoc analysis of many economies would be considered negligible but are modelled for homogeneity reasons.

Furthermore, the structure of the NUTS3 SAMs comprising 63 accounts is as follows:

Table 7 - Structure of the NUTS3 SAM for 2007.

Rural activities	A.0-1_1_R	Small arable crops farms_Rural
	A.0-1_2_R	Large arable crops farms_Rural
	A.0-1_3_R	Small permanent crops farms_Rural
	A.0-1_4_R	Large permanent crops farms_Rural
	A.0-1_5_R	Small other farms_Rural
	A.0-1_6_R	Large other farms_Rural
	A.0-2_R	Products of forestry, logging and related services_Rural
	A.0-3_R	Fish_Rural
	A.0-4_R	Mining_Rural
	A.0-5_R	Food industries_Rural
	A.0-6_R	Other manufacturing_Rural
	A.0-7_R	Utilities_Rural
	A.0-8_R	Construction_Rural
	A.0-9_R	Trade_Rural
	A.0-10_R	Hotels and restaurants_Rural
	A.0-11_R	Transport and communication_Rural
	A.0-12_R	Other private services_Rural
	A.0-13_R	Public services_Rural

[11] For further details, see Cardenete and Sancho (2004).

Urban activities	A.0-1_1_U	Small arable crops farms_Urban
	A.0-1_2_U	Large arable crops farms_Urban
	A.0-1_3_U	Small permanent crops farms_Urban
	A.0-1_4_U	Large permanent crops farms_Urban
	A.0-1_5_U	Small other farms_Urban
	A.0-1_6_U	Large other farms_Urban
	A.0-2_U	Products of forestry, logging and related services_Urban
	A.0-3_U	Fish_Urban
	A.0-4_U	Mining_Urban
	A.0-5_U	Food industries_Urban
	A.0-6_U	Other manufacturing_Urban
	A.0-7_U	Utilities_Urban
	A.0-8_U	Construction_Urban
	A.0-9_U	Trade_Urban
	A.0-10_U	Hotels and restaurants_Urban
	A.0-11_U	Transport and communication_Urban
	A.0-12_U	Other private services_Urban
	A.0-13_U	Public services_Urban
Commodities	C.0-1_1	Arable crops products
	C.0-1_2	Permanent crops products
	C.0-1_3	Other agricultural products
	C.0-2	Products of forestry, logging and related services
	C.0-3	Fish
	C.0-4	Mining
	C.0-5	Food industries
	C.0-6	Other manufacturing
	C.0-7	Utilities
	C.0-8	Construction
	C.0-9	Trade
	C.0-10	Hotels and restaurants
	C.0-11	Transport and communication
	C.0-12	Other private services
	C.0-13	Public services
Factors	SL	Skilled Labour
	UL	Unskilled labour
	K	Capital

Taxes (net)	ANT CNT INT	Activity net taxes Commodity net taxes Income net taxes
Institutional sectors	RH UH E G	Rural households Urban households Enterprises Government
Investment / Save	IS	I-S
Rest of the world	ROW	Rest of the World

Source: Own elaboration.

3 Mapping policies and economic structures

A survey of the CAP implementation at NUTS3 level is presented in this section (financing period 2007-2013 and 2000-2006 when possible). We consider Pillar 1 payments, Pillar 2 payments per axis (programmed and executed), National Payments (RD or other national measures) and private RD share.

3.1 Data collection of CAP Pillars 1 and 2 expenditure

To assess the effects of the CAP in the analysed regions, we collect expenditure data on programs and measures included in Pillar 1 and Pillar 2. For Pillar 1, we use funding from the European Agricultural Fund for Guarantee (EAFG). For the allocation of EAGF aid, we take the amounts specified by item in the corresponding budgets for each NUTS3. Data are directly provided by the European Commission (JRC-IPTS) regarding these items and covering the periods 2007-2011. The level of disaggregation used is as follows:

- 50201 Cereals
- 50202 Rice
- 50203 Refunds on non-Annex 1 products
- 50204 Food programmes
- 50205 Sugar
- 50206 Olive oil
- 50207 Textile plants
- 50208 Fruit and vegetables
- 50209 Products of the wine-growing sector
- 50210 Promotion
- 50211 Other plant products/measures
- 50212 Milk and milk products

- 50213 Beef and veal
- 50214 Sheep meat and goat meat
- 50215 Pig meat, eggs and poultry, bee-keeping and other animal products
- 50216 Sugar Restructuring Fund
- 50301 Decoupled direct aids
- 50302 Other direct aids
- 50303 Additional amounts of aid
- 50304 Ancillary direct aids (outstanding balances, small producers, agri-monetary aids, etc.)
- 50701 Control of agricultural expenditure
- 50702 Settlement of disputes

These amounts are distributed within each region by sector in order to assess the economic impact of these funds. Specifically, they are distributed among the agricultural production sectors considered in the SAMs:

- Small arable crops farms
- Large arable crops farms
- Small permanent crops farms
- Large permanent crops farms
- Small other farms
- Large other farms

The distribution is based on the participation of these subsectors in the structure of the agricultural sector in each NUTS3. In practice, the distribution of these funds is based on the number of farms and their areas by economic size of farm (ESU) and accounts Agricultural according to EAA 97 Rev.1.1, data obtained from Eurostat. Again, the choice of criterion reflects the need for homogeneous breakdowns. Since agricultural branches in the SAMs have been disaggregated following this source of information, it has been decided to consider that aids from the CAP have been distributed among agricultural establishments the same way that these are distributed in their production and agricultural activity in the SAM, i.e., following the EEA 97. The advantages of this choice are the ease of replication of the estimates and uniformity across SAMs. However, there are also disadvantages, because details on the actual allocation of resources may be lost and in turn the specificity of certain regions may be ignored.

Regarding Pillar 2, the European Agricultural Fund for Rural Development (EAFRD), data at NUTS3 level are provided by the European Commission (JRC-IPTS) for expenditure between 2007 and 2011. These data provide the amounts from the rural development fund for each disaggregated NUTS3 by the different measures specified in each area:

Table 8 - EAFRD axes and measures.

1. Improving the competitiveness of agriculture and forestry sector	Human Resources	111	Vocational training and information actions
		112	Setting up of young farmers
		113	Early retirement
		114	Use of advisory services
		115	Setting up of management, relief and advisory services
	Physical capital	121	Modernisation of agricultural holdings
		122	Improvement of the economic value of forests
		123	Adding value to agricultural and forestry products
		124	Cooperation for development of new products, processes and technologies in the agriculture and food sector and in the forestry sector
		125	Infrastructure related to the development and adaptation of agriculture and forestry
		126	Restoring agricultural production potential
	Food quality	131	Meeting standards based on EU legislation
		132	Participation of farmers in food quality schemes
		133	Information and promotion activities
	Transitional measures	141	Semi-subsistence farming
		142	Producer groups
		143	Providing farm advisory and extension services
		144	Holdings undergoing restructuring due to a reform of a common market organisation
2. Improving the environment and the countryside	Sustainable use of agricultural land	211	Natural handicap payments to farmers in mountain areas
		212	Payments to farmers in areas with handicaps, other than mountain areas
		213	Natura 2000 payments and payments linked to Directive 2000/60/EC
		214	Agri-environment payments
		215	Animal welfare payments
		216	Non-productive investments

	Sustainable use of forestry land	221	First afforestation of agricultural land
		222	First establishment of agroforestry systems on agricultural land
		223	First afforestation of non-agricultural land
		224	Natura 2000 payments
		225	Forest-environment payments
		226	Restoring forestry potential and introducing prevention actions
		227	Non-productive investments
3. Quality of life in rural areas and diversification of the rural economy	Diversification of the rural economy	311	Diversification into non-agricultural activities
		312	Support for business creation and development
		313	Encouragement of tourism activities
	Improvement of the quality of life in rural areas	321	Basic services for the economy and rural population
		322	Village renewal and development
		323	Conservation and upgrading of the rural heritage
	Training, skills acquisition and animation	331	Training and information
		341	Skills-acquisition and animation measure with a view to preparing and implementing a local development strategy
4. Leader		411	Competitiveness
		412	Environment/land management
		413	Quality of life/diversification
		421	Implementing cooperation projects
		431	Running the LAG, skills acquisition, animation
		511	Technical assistance
		611	Complimentary direct payments

Source: European Network for Rural Development.

The amounts of these items can be translated into a demand for goods and services to achieve certain goals. The allocation of such amounts has been made taking into account the objective of each of the measures; for example, training measures can be related with increased demand on educational goods and services. Farmer´s training (type M111, *Vocational training and information actions*) include primarily aids related to educational services or consulting tasks that would be included in the field of *Other Private services* and *Public Services*, or even directly targeted to *Households* in the way of grants or subsidies. In the case of measures such as the M312 (*Support for creation and development business*), its purpose indicates the realization of investment and current expenses in *Food Industries* (diversification), *Other Manufacturing* sectors (materials, various inputs for the activity, ..), *Construction* (new buildings and facilities), *Trade*, *Hostels and Restaurants* (aids for leisure and tourism annex to rural development), *Transportation* and Communications (improvements in communication networks), *Other private services* (consulting and other measures of education) and *Public Services* (auxiliary support from Public sector, etc..). Other measures such as M141, Semi-*subsistence farming*, aims to direct aid to farmers (Households), so it is directly assigned to this account, as well as *Early retirement* (M113) or *Payments to farmers* (M211, M212, M213). Table 8b shows an overview of measure allocation between sectors.

The choice of these sectors corresponds to the potential (main) recipients of the various budget actions that fall into each of the measures considered by the EAFRD. The mapping between these measures and sectors is summarised in the following table and the specific CAP assessment is based on the production of each of these sectors in the corresponding NUTS3 (in the amounts shown in the SAMs). Sectors are highly aggregated and each sector incorporates relatively different potential activities that do receive funds, so the distribution of CAP funds is rather straightforward. However, doing so imposes some strong assumptions on the distribution function of final demand. More specific amounts for each sector are very difficult to estimate without specific fieldwork and falls outside the scope of this work. Therefore it is assumed that sectors with more weight in each region are those which receive most funds within each measure involved. Yet, the use of highly aggregated sectors softens the impact of this scenario. Therefore, specific allocation of the amounts of each measure to the economic sectors was performed individually for each NUTS3, using as criteria the sectoral output data obtained from the SAMS built for them and I-O tables used as a basis for this work. Table 8c1-2 gives an example of such distribution in some NUTS3 included in the study (Konstanz and Heves).

Table 8b - General assigning of EAFRD measures to activity sectors.

Measure	Food Industries	Other manufacturing	Utilities	Construction	Trade	Hotels and restaurants	Transport and communication	Other private services	Public services	Households
111								X	X	
112		X		X			X		X	
113										X
114								X	X	
115								X	X	
121		X		X			X	X	X	
122		X		X			X	X	X	
123								X	X	
124								X	X	
125		X		X			X	X	X	
126		X		X			X	X	X	
131								X	X	
132								X	X	
133								X	X	
141										X
142		X		X			X	X	X	
143								X	X	
144		X		X			X	X	X	
211										X
212										X
213										X
214		X		X			X	X	X	
215		X		X			X	X	X	
216		X		X			X	X	X	
221		X		X			X	X	X	
222		X		X			X	X	X	
223		X		X			X	X	X	
224		X		X			X	X	X	
225		X		X			X	X	X	
226		X		X			X	X	X	
227		X		X			X	X	X	
311	X	X		X	X	X	X	X	X	
312	X	X		X	X	X	X	X	X	
313						X				
321								X	X	
322				X				X	X	

323				X				X	X	
331								X	X	
341								X	X	
411								X	X	
412								X	X	
413								X	X	
421								X	X	
431								X	X	
511								X	X	
611										

Source: Own elaboration.

Table 8c1 – Assigning of EAFRD measures to activity sectors in Konstanz.

Measure	Food Industries	Other manufacturing	Utilities	Construction	Trade	Hotels and restaurants	Transport and communication	Other private services	Public services	Households
111								60.4%	39.6%	
112		48.9%		9.2%			14.6%		27.3%	
113										100.0%
114								60.4%	39.6%	
115								60.4%	39.6%	
121		34.5%		6.5%			10.3%	29.4%	19.2%	
122		34.5%		6.5%			10.3%	29.4%	19.2%	
123								60.4%	39.6%	
124								60.4%	39.6%	
125		34.5%		6.5%			10.3%	29.4%	19.2%	
126		34.5%		6.5%			10.3%	29.4%	19.2%	
131								60.4%	39.6%	
132								60.4%	39.6%	
133								60.4%	39.6%	
141										100.0%
142		34.5%		6.5%			10.3%	29.4%	19.2%	
143								60.4%	39.6%	
144		34.5%		6.5%			10.3%	29.4%	19.2%	
211										100.0%
212										100.0%
213										100.0%
214		34.5%		6.5%			10.3%	29.4%	19.2%	
215		34.5%		6.5%			10.3%	29.4%	19.2%	

216		34.5%		6.5%			10.3%	29.4%	19.2%	
221		34.5%		6.5%			10.3%	29.4%	19.2%	
222		34.5%		6.5%			10.3%	29.4%	19.2%	
223		34.5%		6.5%			10.3%	29.4%	19.2%	
224		34.5%		6.5%			10.3%	29.4%	19.2%	
225		34.5%		6.5%			10.3%	29.4%	19.2%	
226		34.5%		6.5%			10.3%	29.4%	19.2%	
227		34.5%		6.5%			10.3%	29.4%	19.2%	
311	5.2%	28.4%		5.4%	10.8%	1.6%	8.5%	24.2%	15.9%	
312	5.2%	28.4%		5.4%	10.8%	1.6%	8.5%	24.2%	15.9%	
313						100.0%				
321								60.4%	39.6%	
322				11.8%				53.3%	34.9%	
323				11.8%				53.3%	34.9%	
331								60.4%	39.6%	
341								60.4%	39.6%	
411								60.4%	39.6%	
412								60.4%	39.6%	
413								60.4%	39.6%	
421								60.4%	39.6%	
431								60.4%	39.6%	
511								60.4%	39.6%	
611										

Source: Own elaboration.

Table 8c2 - Assigning of EAFRD measures to activity sectors in Heves.

Measure	Food Industries	Other manufacturing	Utilities	Construction	Trade	Hotels and restaurants	Transport and communication	Other private services	Public services	Households
111								58.8%	41.2%	
112		61.8%		9.9%			11.0%		17.3%	
113										100.0%
114								58.8%	41.2%	
115								58.8%	41.2%	
121		49.6%		7.9%			8.8%	19.8%	13.9%	
122		49.6%		7.9%			8.8%	19.8%	13.9%	
123								58.8%	41.2%	
124								58.8%	41.2%	
125		49.6%		7.9%			8.8%	19.8%	13.9%	

126		49.6%		7.9%			8.8%	19.8%	13.9%	
131								58.8%	41.2%	
132								58.8%	41.2%	
133								58.8%	41.2%	
141										100.0%
142		49.6%		7.9%			8.8%	19.8%	13.9%	
143								58.8%	41.2%	
144		49.6%		7.9%			8.8%	19.8%	13.9%	
211										100.0%
212										100.0%
213										100.0%
214		49.6%		7.9%			8.8%	19.8%	13.9%	
215		49.6%		7.9%			8.8%	19.8%	13.9%	
216		49.6%		7.9%			8.8%	19.8%	13.9%	
221		49.6%		7.9%			8.8%	19.8%	13.9%	
222		49.6%		7.9%			8.8%	19.8%	13.9%	
223		49.6%		7.9%			8.8%	19.8%	13.9%	
224		49.6%		7.9%			8.8%	19.8%	13.9%	
225		49.6%		7.9%			8.8%	19.8%	13.9%	
226		49.6%		7.9%			8.8%	19.8%	13.9%	
227		49.6%		7.9%			8.8%	19.8%	13.9%	
311	7.8%	40.7%		6.5%	8.7%	1.3%	7.2%	16.3%	11.4%	
312	7.8%	40.7%		6.5%	8.7%	1.3%	7.2%	16.3%	11.4%	
313						100.0%				
321								58.8%	41.2%	
322				19.0%				47.6%	33.4%	
323				19.0%				47.6%	33.4%	
331								58.8%	41.2%	
341								58.8%	41.2%	
411								58.8%	41.2%	
412								58.8%	41.2%	
413								58.8%	41.2%	
421								58.8%	41.2%	
431								58.8%	41.2%	
511								58.8%	41.2%	
611										

Source: Own elaboration.

3.2 Structural description of regional economies

3.2.1 Background

This section analyses the economic structure of the NUTS3 regions with a view to detect the most important economic sectors in each region. We further use the SimSIP SAM software[12] (Parra and Wodon, 2008) to analyse the impact of the CAP in these areas. In this study, the software is used to detect backward and forward structural linkages as well as key sectors. Key sector analysis makes it possible to extract the main trends in the behaviour of an economy and to develop its corresponding structural view.

The methodologies commonly used to determine productive key sectors are usually classified into two categories: *traditional methods*, and *hypothetical extraction methods*. Briefly, both methods are based on the combination of two indicators: a *backward linkage* (*BL*) and a *forward linkage* (*FL*), both traditionally obtained from a symmetrical input-output table.

The backward linkage indicator (*BL*) for a given sector reflects the effect of a change in the final demand of this specific sector on the economy's total production, whereas the forward linkage indicator (*FL*) values the effect of a change in the final demand of all sectors in the economy on the production of the specific sector concerned.

Key sectors in an economy are determined on the base of these indicators. Key sectors generate a high multiplier and fostering effect on production, allowing development strategies to be designed upon them as part of the economic policies.

In this analysis we use SAMS, more complex than the traditional SIOT to determine the key sectors. The SAM is an enlargement of the traditional input-output framework in the sense that considers and reflects the complete circular flow of income, as described in the previous sections. From this perspective, the measurement of economic transactions incorporated in a SAM allows to extract more precise information about the different economic agents, such as producers, consumers, public administration and the foreign sector, as well as about the behaviour of the productive factors[13].

[12] SimSIP SAM is a user-friendly Excel-based application to analyse SAMs and I-O tables. The tool works with MATLAB as the computation engine and no license or knowledge of MATLAB is required. It performs a large number of decompositions and analyses including two algorithms for SAM balancing (RAS and Cross Entropy Method), SAM aggregation, multiplier decompositions, several types of economic linkages, income-redistribution analysis, structural-path analysis, several methods to analyse structural change (fields of influence, direction of change, importance of technical coefficients), supply constraints, price models, price controls, together with poverty and income-distribution analysis by linking the tool to household survey data. Several studies have been developed with SIMSIPSAM software. See Bostwick (2012), Nganou et al. (2011), Fofana et al. (2011) and Parra (2008) as an example.

[13] For a demonstration of the advantages in the use of multipliers based on SAM instead of IO, see Roland-Holst, D.W. (1990).

3.2.2 Analysis of Key Sectors

The analysis of linkages, used to examine the interdependences between productive structures, has a long history starting from the pioneer works of Chenery and Watanabe (1958), Rasmussen (1956) or Hirschman (1958).

In this analysis we use the methodology developed by Rasmussen (1956) to obtain the *BL*, and that of Augustinovics (1970), designed to obtain the *FL*, both of them are traditional methods. More precisely, for the *BL* the method suggests that the calculations shall be done from a SAM rather than a SIOT. Such SAM should have a high degree of endogenisation of institutional sectors, so that the circular flow of income can be adequately closed. At least, productive factors (labour and capital) and households should be endogenized. Thus, when analysing *BL*, the change in the final demand of a certain sector will reflect how the rest of the sectors change in order to "supply" the alteration in the final demand. Furthermore, since the productive activity will increase, the remuneration of production factors and consumers' expenditures will increase as well, thus influencing again the productive sectors in a "second round".

Starting with the method proposed by Rasmussen (1956), from the associated inverse matrix $B_t = (I - A_t)^{-1}$, being I an identity matrix of size *n*, we obtain the expression of the *BL*:

$$B_{.j} = \sum_{i=1}^{n} b_{ij} \qquad j = 1 \dots n \qquad (2)$$

b_{ij} denoting the elements of the inverse matrix associated B_t.

Once this indicator is normalised, if the backward linkage is greater than one, a one-unit change in the final demand of sector *j* will generate an increase higher than the average in the economy's global activity.

In 1976, Jones stated that obtaining the *FL* as defined by Rasmussen (thus symmetrically to the *BL)* did not allow the same degree of quality than for the *BL*, and, from a similar perspective, Augustinovics (1970) had already defined the *FL* as the row sum of the Goshian inverse, where the distribution coefficients (δ_{ij}) – obtained from the symmetrical IOT through dividing each cell by the row total, not the column total – replace the technical coefficients. This way, *FL* is calculated as $O_{i.}$:

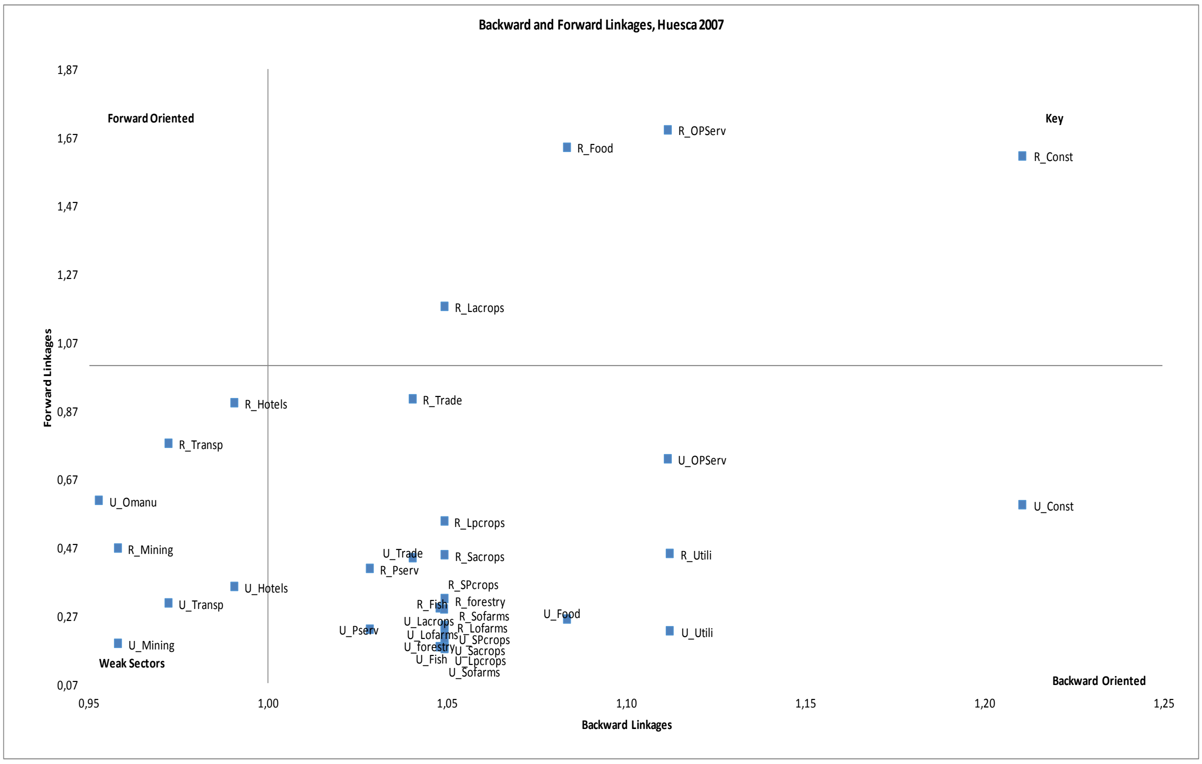
$$O_{i.} = \sum_{j=1}^{n} \delta_{ij} \qquad i = 1 \dots n \qquad (3)$$

from which we can measure the effect of a change in the supply of primary inputs in a particular sector on the whole economy. After its normalization, if the indicator is greater than one, a one unit change in the final demand of all sectors, will generate an increase above the average in sector *i*. In the case of *FL*, the SIOT rather than the SAM should be the base for the calculation because, primary inputs remain exogenous, which are the thread of the circular flow of income, otherwise the economic interpretation lying in the *FL* would lose its meaning once the institutional sectors are endogenised through the use of the SAM.

Below, we present results by cluster with the corresponding backward and forward linkages and key sectors for each NUTS3 region graphically: activities are classified according to the size of their forward and backward linkages. A key sector is usually defined as one with both backward and forward linkages greater than 1. A sector with backward (forward) linkages greater than 1, and forward (backward) linkages below 1, is called backward (forward) oriented. If none of the linkages is greater than 1, the sector is called weak.

- Cluster 5 (Rural areas strongly dependent on agriculture with low GDP and accessibility): Huesca.

Figure 2 – BL and FL for Huesca, 2007.

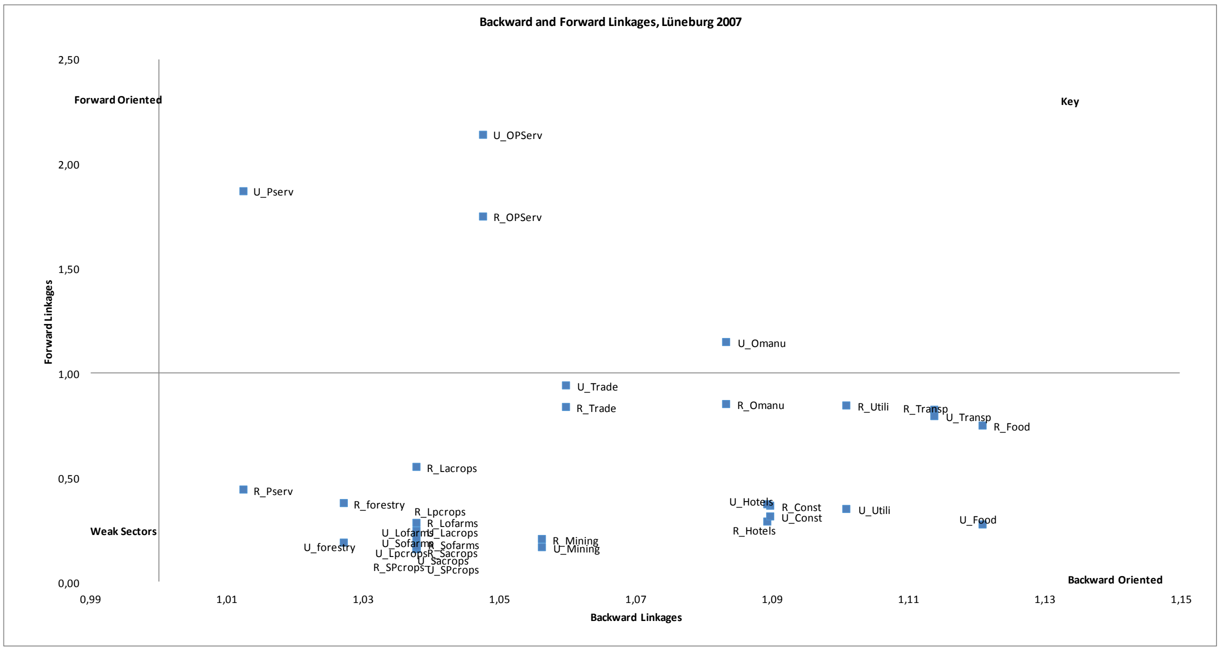


Source: Own elaboration.

In the specific case of Huesca, the majority of sectors can be classified as backward oriented, whereas only four sectors (all rural, two of them linked to agriculture and food industries) can be categorized as key (sectors R_Lacrops, R_Food, R_Const and R_OPServ). The rest are either backward oriented or weak sectors.

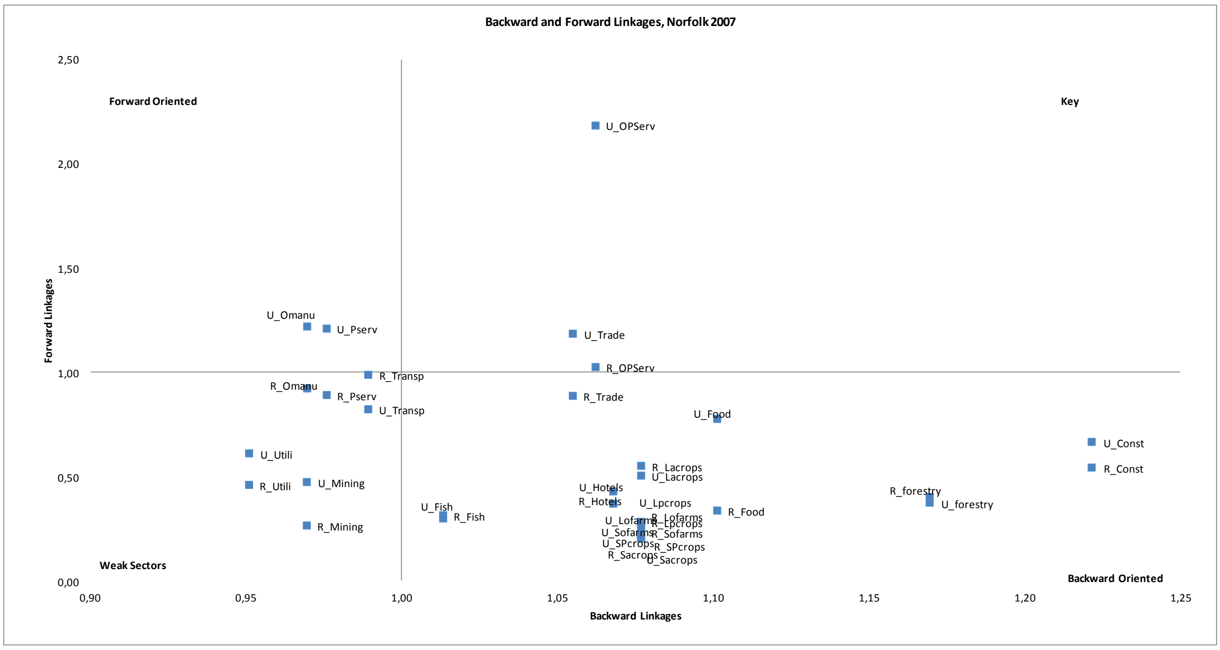
- <u>Cluster 1 (intermediate urban/rural areas, economically diversified with high GDP and accessibility) :Lüneburg, Norfolk, Konstanz.</u>

Figure 3 – BL and FL for Lüneburg, 2007.



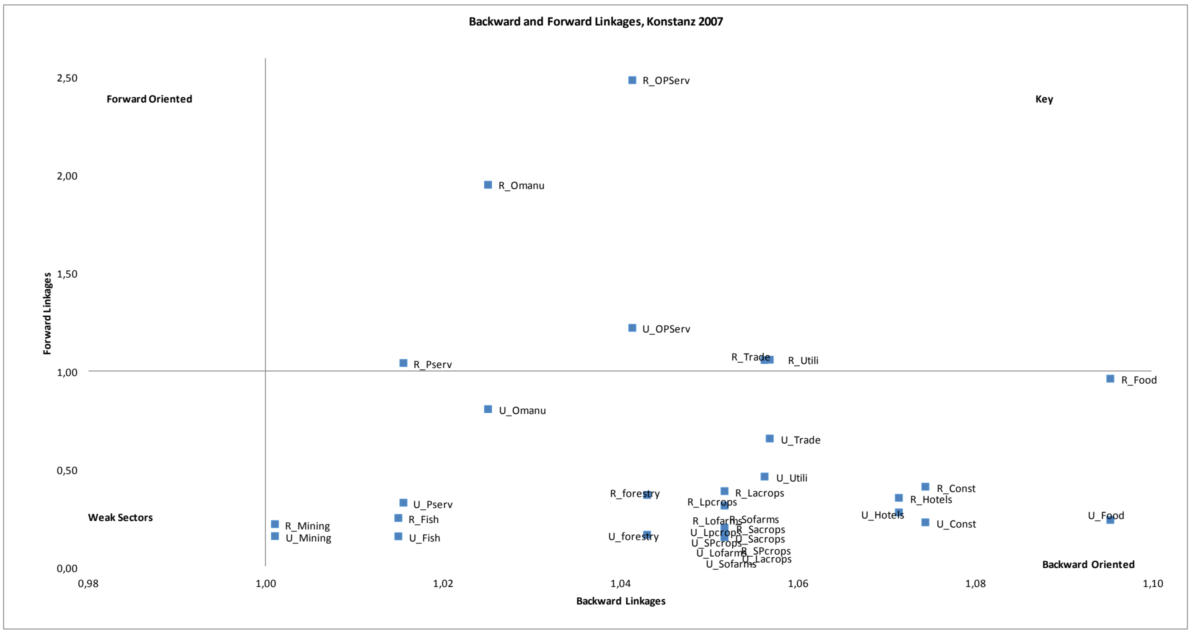
Source: Own elaboration.

Figure 4 – BL and FL for Norfolk, 2007.



Source: Own elaboration.

Figure 5 - BL and FL for Konstanz, 2007.



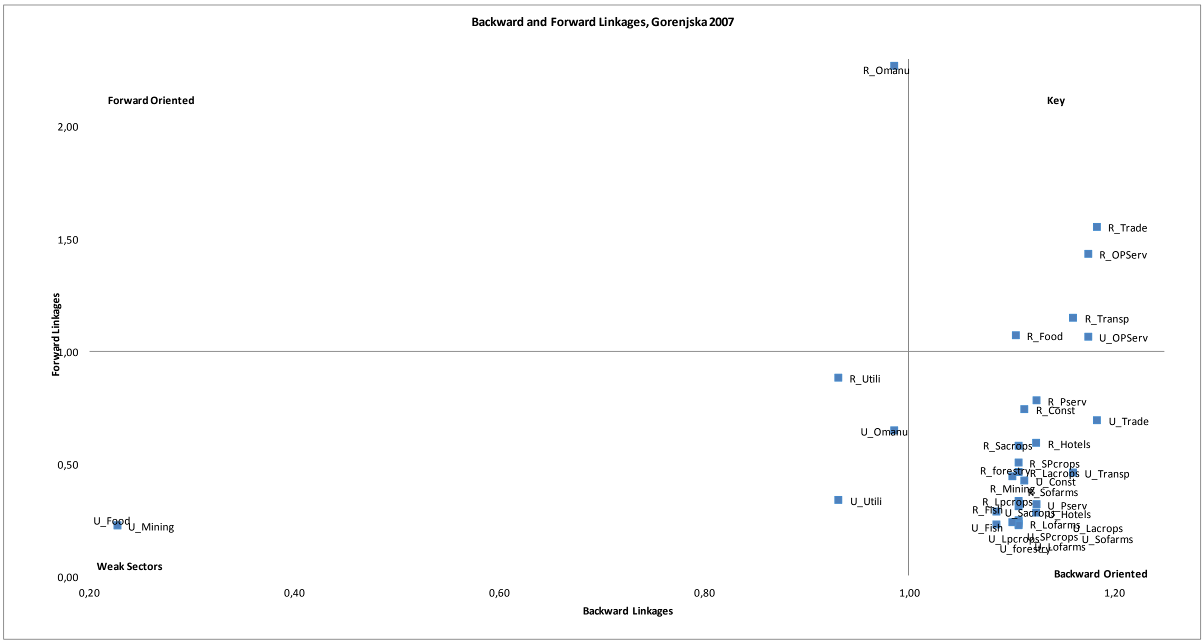
Source: Own elaboration.

The analysis of cluster 1 is presented in Figures 3, 4 and 5. Figure 3 shows that sectors categorised as key in Lüneburg are R_OPServ, U_Omanu, U_OPServ and U_Pserv. The majority of the sectors can be classified as backward oriented in this region. In the case of Norfolk, R_OPServ, U_Trade, U_OPServ can be categorised as key sectors. U_Omanu, U_Pserv are forward oriented and R_Mining, R_Omanu, R_Utili, R_Transp, R_Pserv, U_Mining, U_Utili, U_Transp are weak sectors. Regarding Konstanz, the majority of sectors are backward oriented but there are six key sectors: R_OPServ, R_Omanu, U_OPServ, R_Pserv, R_Utili and R_Trade.

In this first cluster we can find some similarities regarding key sectors, the three regions register a huge majority of backward oriented sectors and share some key sectors such as rural and urban private services, R_OPServ and U_OPServ.

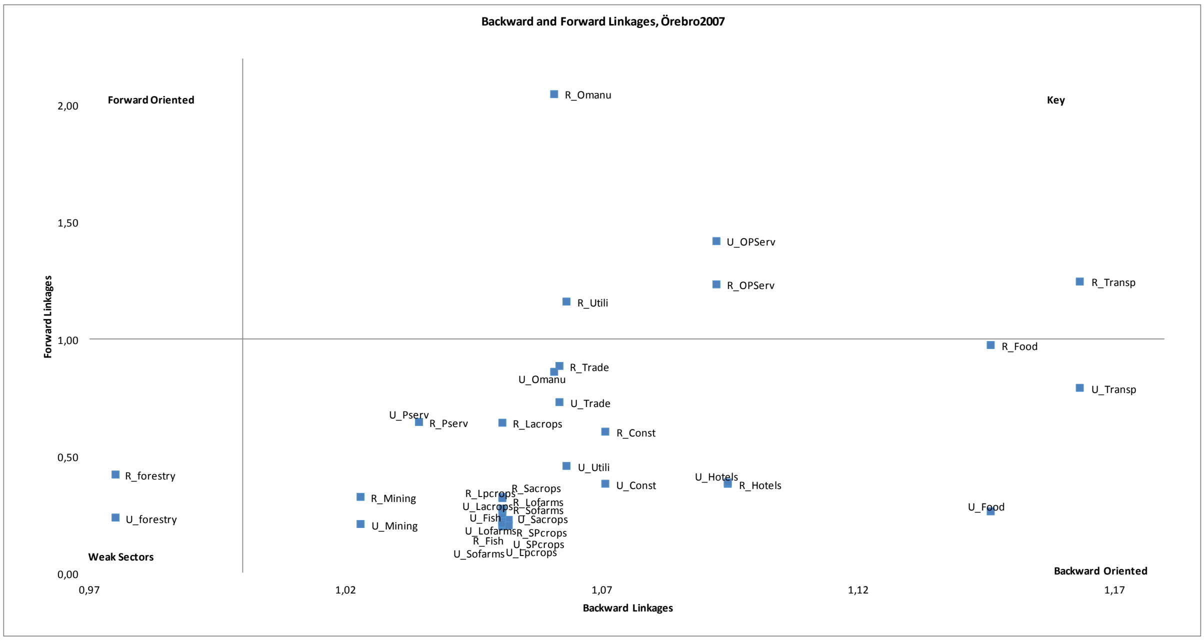
- <u>Cluster 2 (rural areas depending on agriculture with high GDP and accessibility): Gorejnska, Örebro, Noord Drenthe, Finistère.</u>

Figure 6 – BL and FL for Gorenjska, 2007.



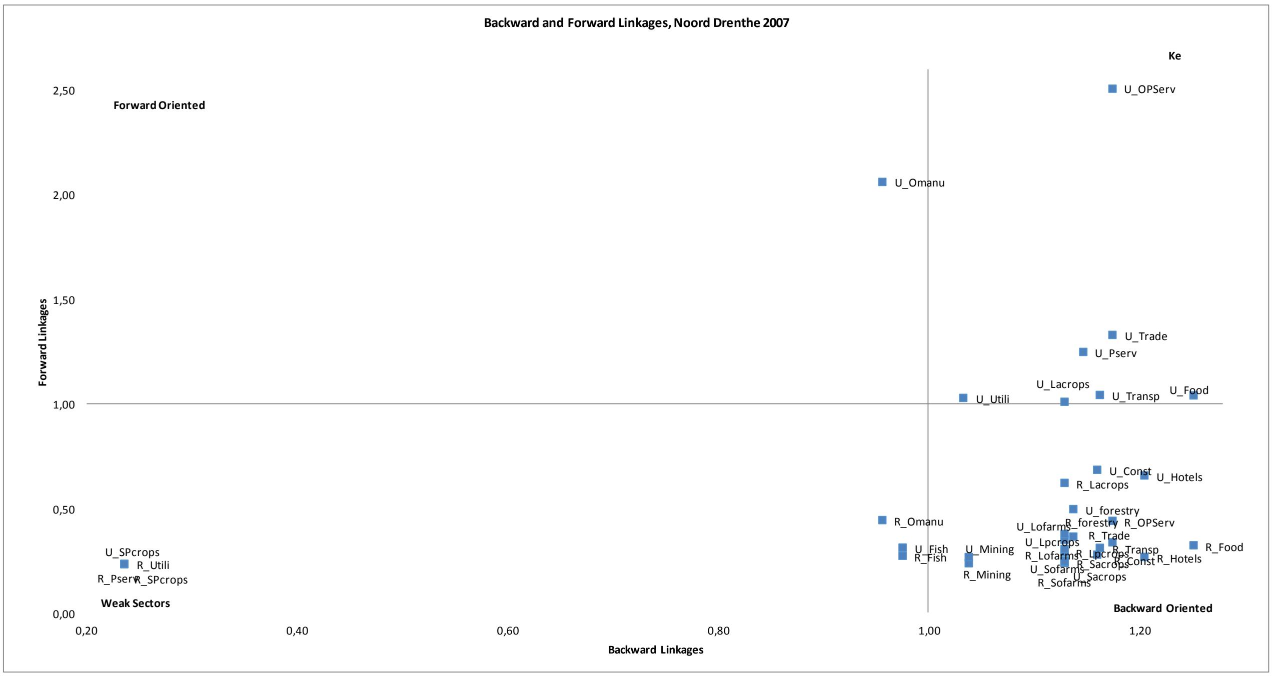
Source: Own elaboration.

Figure 7 – BL and FL for Örebro, 2007.



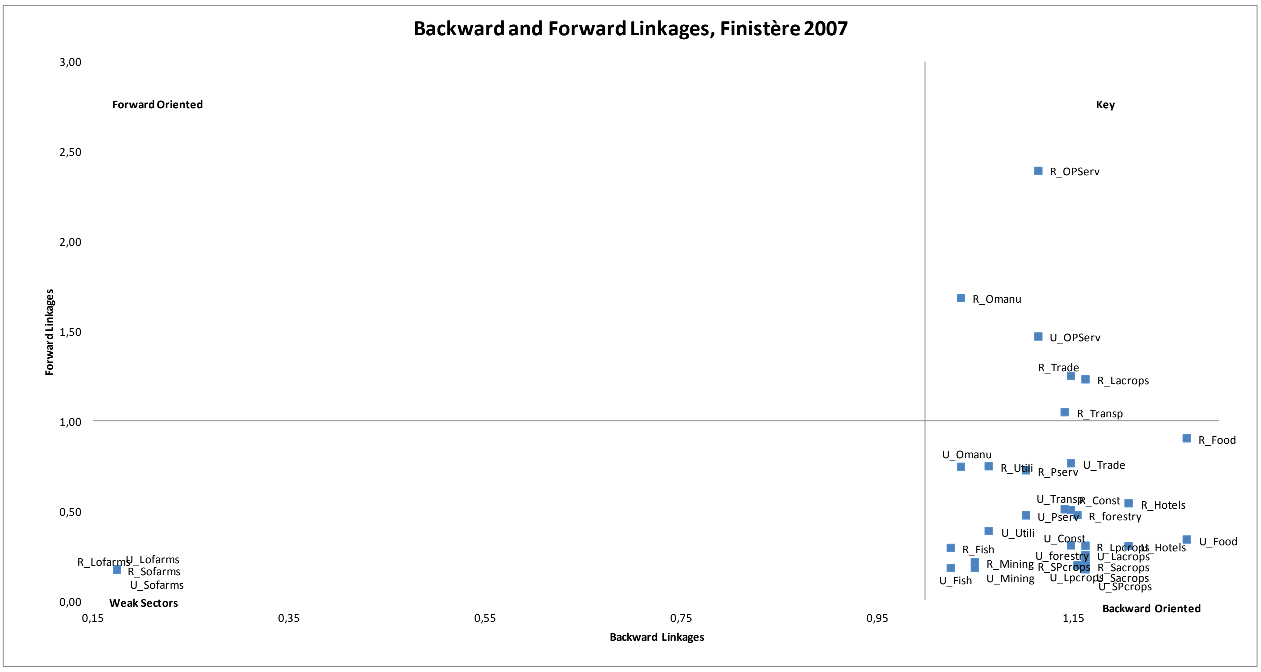
Source: Own elaboration.

Figure 8 - BL and FL for Noord Drenthe, 2007.



Source: Own elaboration.

Figure 9 - BL and FL for Finistère, 2007.



Source: Own elaboration.

The majority of sectors can be classified as backward oriented in this case for this cluster of regions.

Figure 6 shows the classification of Gorenjska where we can categorize as key sectors R_Food, R_Trade, R_Transp, R_OPServ and U_OPServ. The forward oriented sector is R_Omanu and the weak sectors R_Utili, U_Mining, U_Food, U_Omanu, U_Utili.

In Figure 7, we present the results for Örebro, where key sectors are R_Omanu, R_Utili, R_Transp, R_OPServ and U_OPServ. In this region, the weak sectors are R_forestry and U_forestry. In this case there are not forward oriented sectors and the rest of sectors are backward oriented.

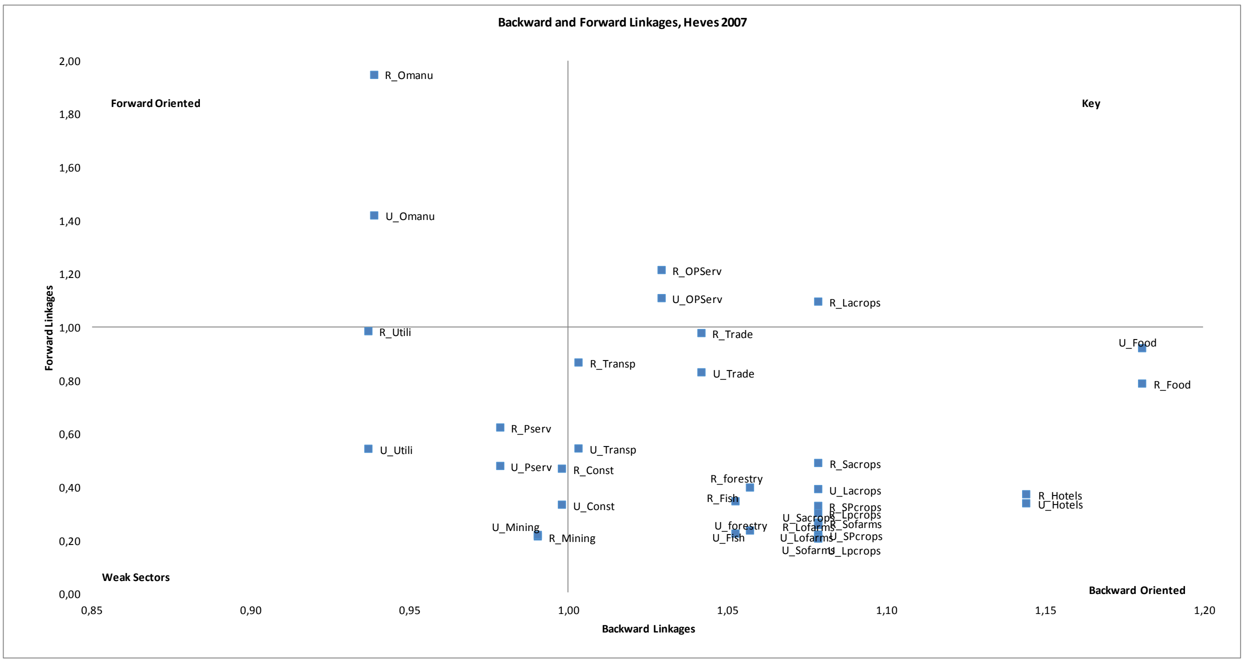
The analysis of Noord Drenthe can be consulted in Figure 8. The key sectors are U_Lacrops, U_Food, U_Utili, U_Trade, U_Transp, U_OPServ and U_Pserv. The forward oriented ones are U_Omanu. Finally, the weak sectors are R_Spcrops, R_Fish, R_Omanu, R_Utili, R_Pserv, U_Spcrops, U_Fish. Again the rest are backward oriented.

In Figure 9, we can see the classification for Finistère. As key, we can find R_Lacrops, R_Omanu, R_Trade, R_Transp, R_OPServ, U_OPServ, whereas R_Sofarms, R_Lofarms, U_Sofarms, U_Lofarms can be classified as weak sectors. The others are backward oriented.

Searching for common patterns in this cluster, some coincidences can be found. There is a majority of backward oriented sectors within the cluster and urban private services U_OPServ is also key sectors in the four regions(R-OPServ is key in three regions too). It is important to remark that the regions Gorenjska, Örebro and Finistère register a closer pattern while Noord Drenthe has a different structure classification with a higher number of key sectors.

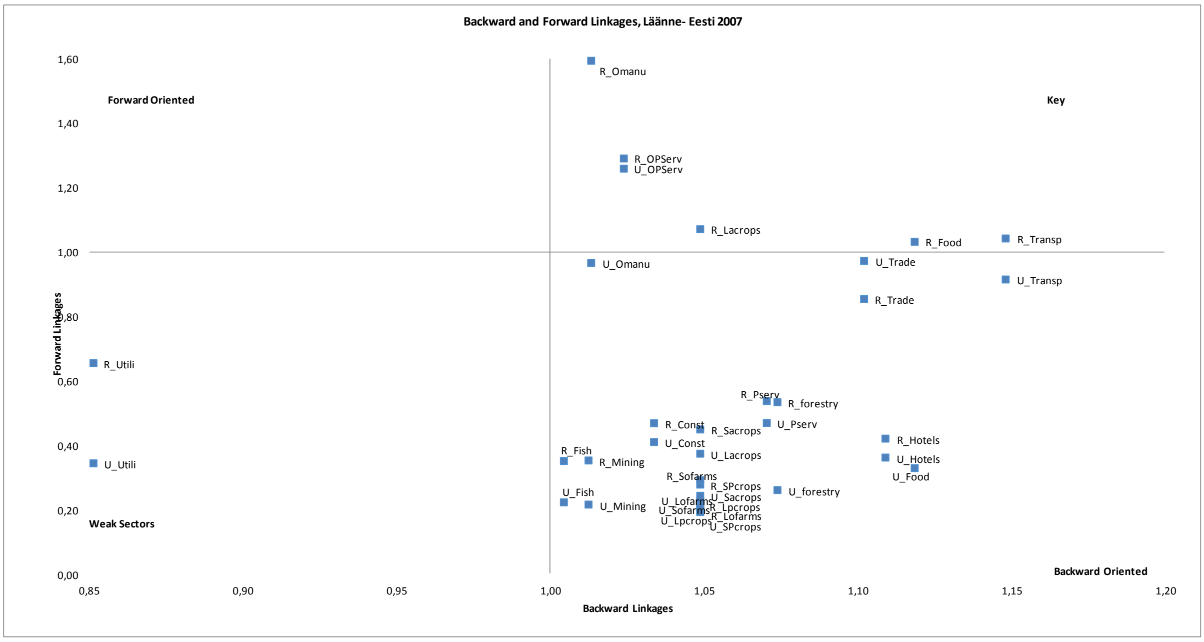
- Cluster 3 (predominantly rural areas with low GDP and low accessibility): Heves, Lääne – Eesti, Slupski.

Figure 10 - BL and FL for Heves, 2007.



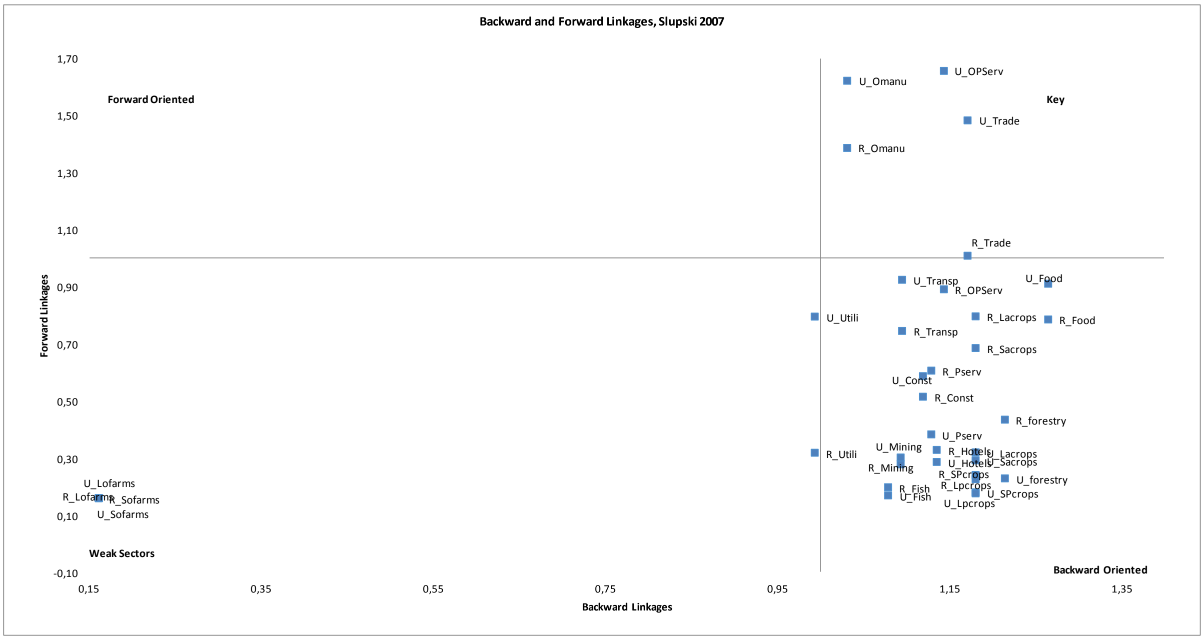
Source: Own elaboration.

Figure 11 - BL and FL for Lääne-Eesti, 2007.



Source: Own elaboration.

Figure 12 - BL and FL for Slupski, 2007.



Source: Own elaboration.

The analysis of cluster 3 is presented in Figures 10, 11 and 12. The majority of sectors can be classified as backward oriented. The analysis of Heves is visualised in Figure 10. It shows the sectors that can be categorised as key: R_Lacrops, R_OPServ and U_OPServ. The forward oriented ones are R_Omanu and U_Omanu and the rest are weak sectors: R_Mining, R_Utili, R_Const, R_Pserv, U_Mining, U_Utili, U_Const and U_Pserv.

The analysis of Lääne Eeesti is visualised in Figure 11. In this region, the sectors that can be categorised as key are R_Lacrops, R_Food, R_Omanu, R_Transp, R_OPServ and

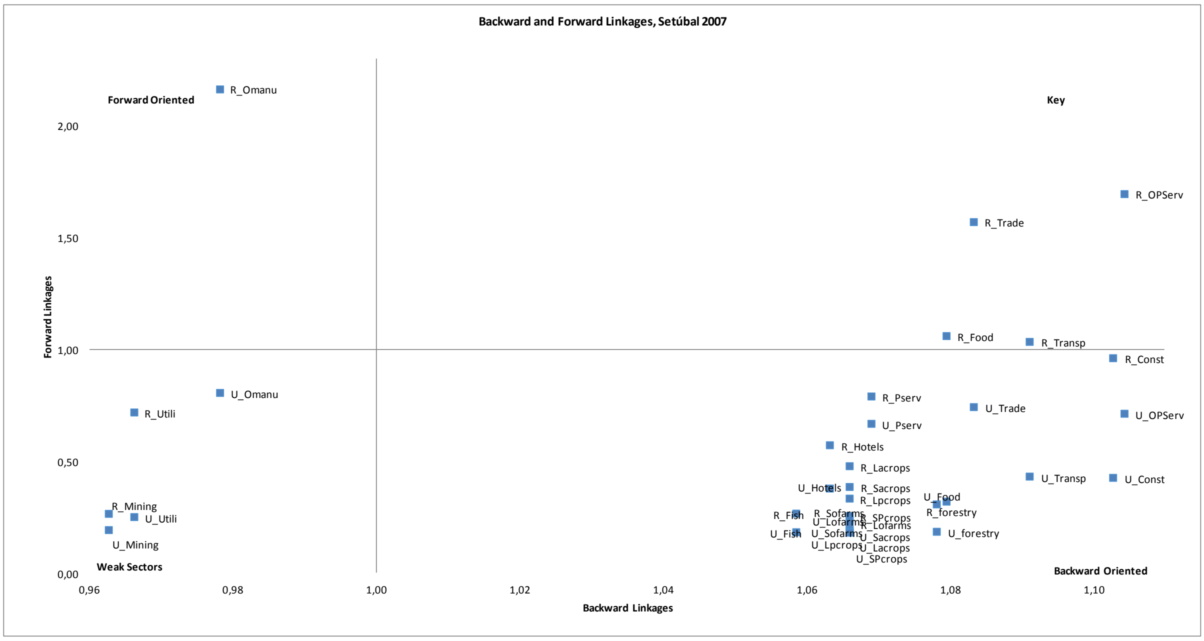
U_OPServ. The weak sectors are R_Utili and U_Utili. In this case there are not sectors classified as forward oriented.

The analysis of Slupski is in Figure 12. The sectors classified as key are R_Omanu, R_Trade, U_Omanu, U_Trade and U_OPServ while the weak sectors are R_Sofarms, R_Lofarms, R_Utili, U_Sofarms, U_Lofarms and U_Utili.

In this cluster we can point out some similarities regarding the classification of sectors, with coincidences in most of backward oriented sectors and being U_OPServ key sector for the three regions.

- Cluster 6 (urban areas with low GDP and intermediate accessibility) : Setúbal.

Figure 13 - BL and FL for Setúbal, 2007.



Source: Own elaboration.

Figure 13 shows the analysis of cluster 6 represented by Setúbal, where most of sectors can be classified as backward oriented, whereas some rural sectors are key (R_Food, R_Trade, R_Transp and R_OPServ), the rest being forward oriented (R_Omanu) and weak sectors (R_Mining, R_Utili, U_Mining, U_Omanu and U_Utili).

To summarise, Table 9 shows the key sectors for each NUTS3. These activities represent the sectors with the “diffusion effect” and the “absorption effect”.

Table 9 - Key Sectors by cluster and NUTS3 regions.

	NUTS 3	Rural	Urban
Cluster 5	**Huesca**	(2) Large arable crops farms; (10) Food industries; (13) Construction; (17) Other private services	
Cluster 1	**Lüneburg**	(17) Other private services	(29) Other manufacturing; (35) Other private services; (36) Public services
	Norfolk	(17) Other private services	(32) Trade; (35) Other private services
	Konstanz	(11) Other manufacturing; (12) Utilities; (14) Trade; (16) Transport and communication; (17) Other private services; (18) Public services	(35) Other private services
Cluster 2	**Gorenjska**	(10) Food industries; (14) Trade; (16) Transport and communication; (17) Other private services	(35) Other private services
	Örebro	(11) Other manufacturing; (12) Utilities; (16) Transport and communication	(35) Other private services
	Noord Drenthe		(20) Large arable crops farms; (28) Food industries; (30) Utilities; (32) Trade; (34) Transport and communication; (35) Other private services; (36) Public services
	Finistère	(2) Large arable crops farms; (11) Other manufacturing; (14) Trade; (16) Transport and communication; (17) Other private services	(35) Other private services
Cluster 3	**Heves**	(2) Large arable crops farms; (17) Other private services	(35) Other private services
	Lääne-Eesti	(2) Large arable crops farms; (10) Food industries; (11) Other manufacturing; (16) Transport and communication; (17) Other private services	(35) Other private services

	Slupski	(11) Other manufacturing; (14) Trade	(29) Other manufacturing; (32) Trade; (35) Other private services
Cluster 6	**Setúbal**	(10) Food industries; (14) Trade; (16) Transport and communication; (17) Other private services	

Source: Own elaboration.

3.2.3 Structural-path analysis

3.2.3.1 Background

Following Sonis et al. (1997), to complete this sectoral perspective of the different regions, we calculate the Multiplier Product Matrix (MPM) derived from the SAM, which allows us analysing the sectoral interdependencies of these economies. *M* defines the elements of this matrix as the product of the multiplier *M* row (M_i) and column (M_j) divided by total intensity factor, (this factor is calculated as the sum of all elements of matrix *M*):

$$MPM_{ij} = \frac{M_{i.} \cdot M_{.j}}{\sum_{i=1}^{n}\sum_{j=1}^{n} M_{ij}} \qquad (4)$$

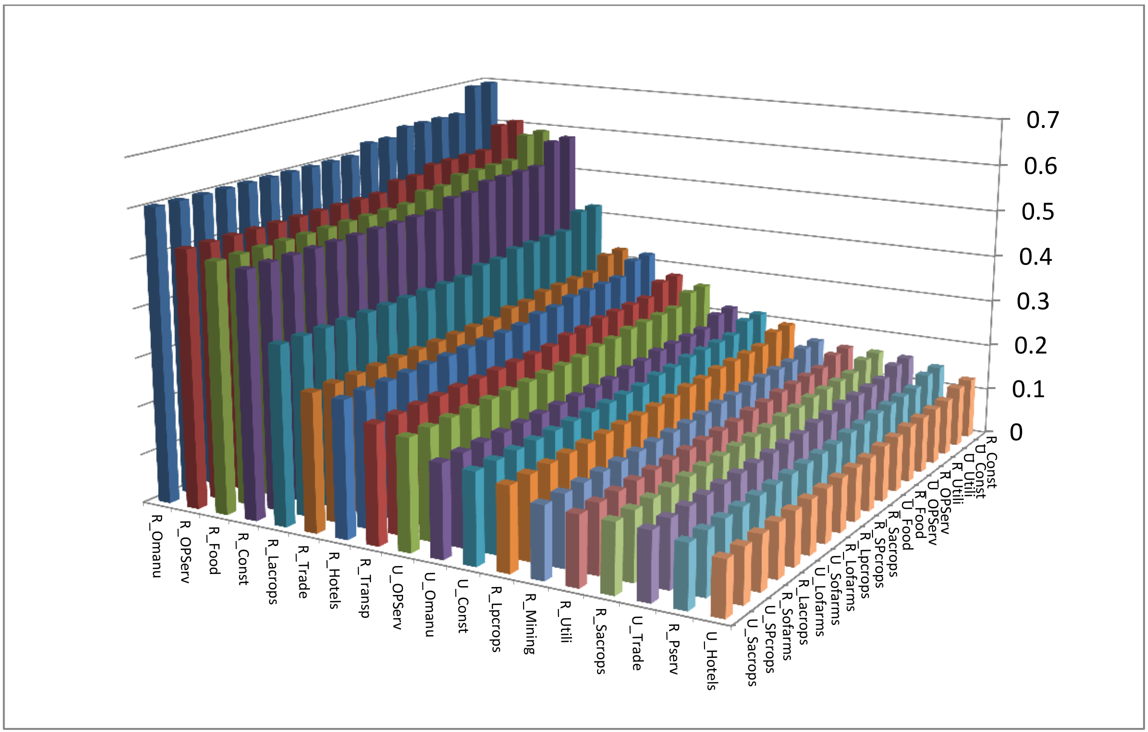
Thus, the MPM structure is essentially connected with the properties of sector backward and forward linkages. The rows and columns of the matrix M can be rearranged along the magnitude of the values of backward and forward linkages from the largest to the smallest to provide the hierarchy of backward (for columns) and forward (for rows) linkages. Using the MPM matrix, it is possible to construct economic landscapes to provide a summary view of the economic structure, that allows visually identifying which are the sectors that generate above-average impact on the economy through changes in themselves, what are the sectors that are most influenced by changes in the rest of the economy, and how they interact with the rest of the other sectors.

3.2.3.2 Economic Landscape NUTS3

In this section, we develop the landscapes for each NUTS3, presenting the most important links between the main 18 accounts in each economy. The multiplier product matrix (MPM) denotes the first order change in the sum of all elements of the inverse matrix caused by the change in the (i, j)-th technical coefficient. The elements of the MPM can be sorted, to get a graphical representation of the hierarchies of backward and forward linkages known as economic landscape. The MPM is also known as first order intensity field of influence. The cell (i, j) quantifies the first order change in the sum of all terms in the inverse matrix generated by a change in the technical coefficient (i, j). If the columns and rows of the MPM are reordered in such a way that the highest element of the matrix is in cell (1, 1), the next highest (excluding the new first row and column) is in cell (2,2), and so on, the graph of the resulting matrix is called the economic landscape.

- <u>Cluster 5 (Rural areas strongly dependent on agriculture with low GDP and accessibility): Huesca.</u>

Figure 14 - Landscape, Huesca 2007.

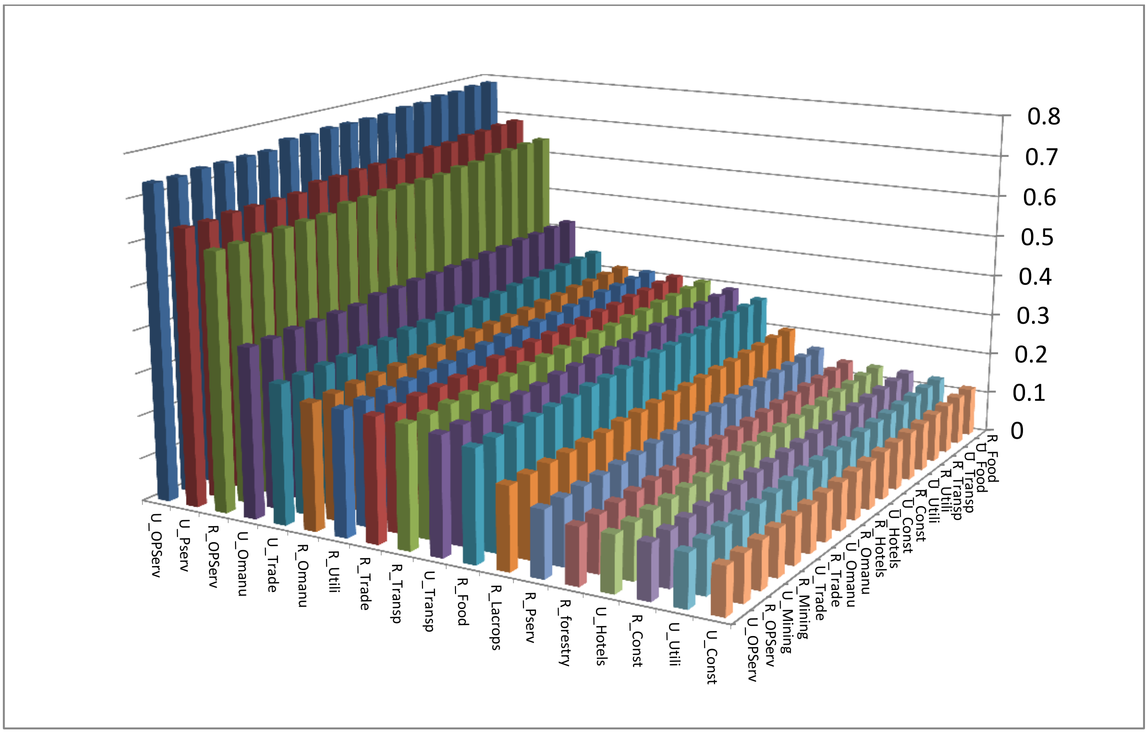


Source: Own elaboration.

In Figure 14 we can identify the most important sectors and linkages in the economy of Huesca (cluster 5) using structural path analysis. These sectors are Other manufacturing_Rural (11), Other private services_Rural (17) and Food industries_Rural (10). With this landscape, we can look for links between sectors; so, we can see that Other manufacturing_Rural (11) and Construction_Rural (13) register the closest link because the highest forward linkage value corresponds to Other manufacturing_Rural (11) and the one for backward linkages is Construction_Rural (13).

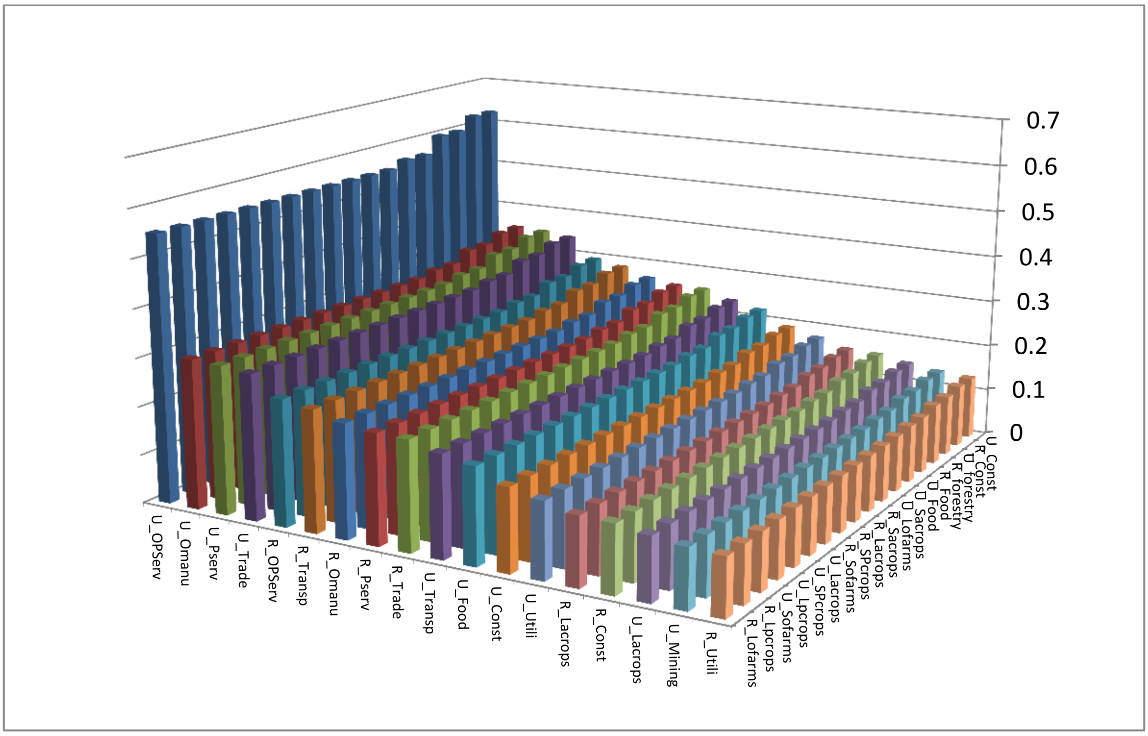
- Cluster 1 (intermadiate urban/rural areas, economically diversified with high GDP and accessibility): Lüneburg, Norfolk, Konstanz.

Figure 15 – Landscape, Lüneburg 2007.



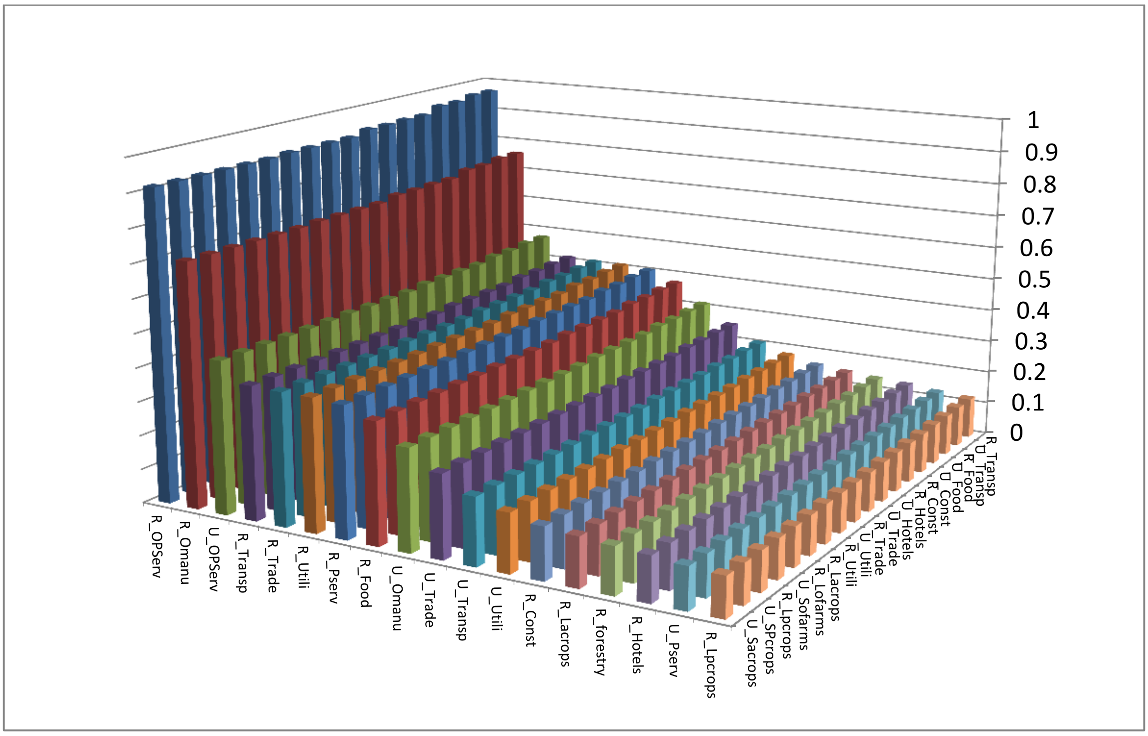
Source: Own elaboration.

Figure 16 – Landscape, Norfolk 2007.



Source: Own elaboration.

Figure 17 – Landscape, Konstanz 2007.



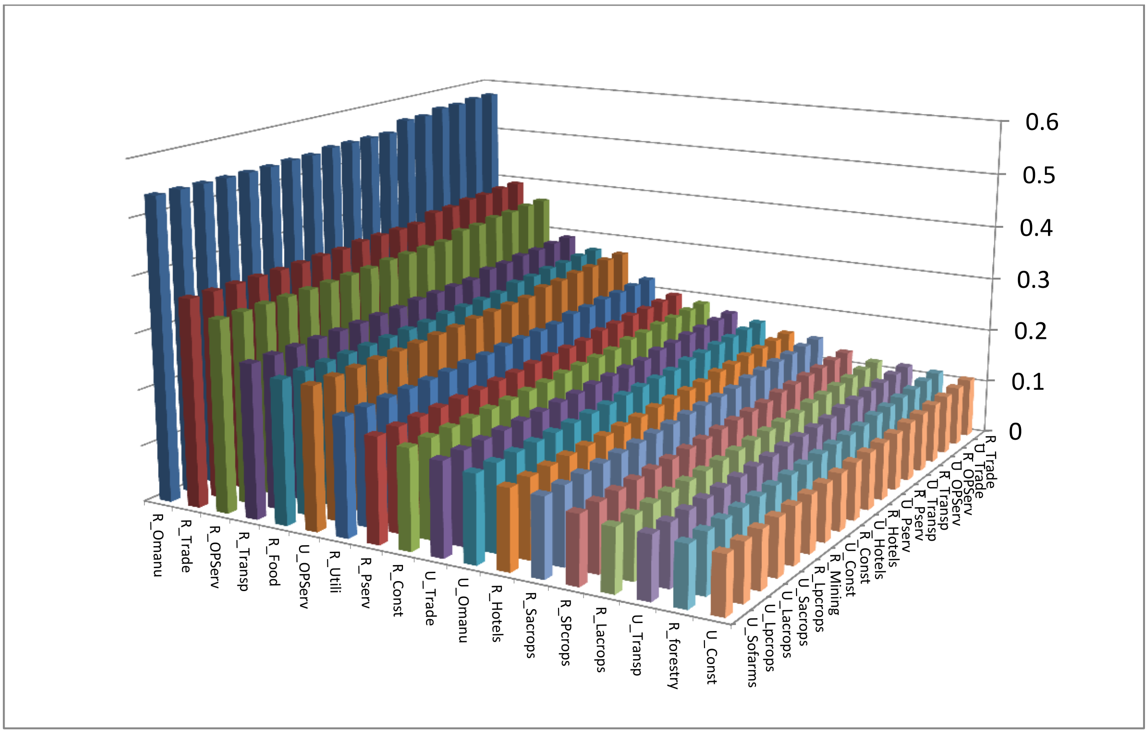
Source: Own elaboration.

Economic landscapes of cluster 1 are presented in Figure 15, 16 and 17. In Figure 15 for the Lüneburg economy, those sectors with higher importance in this region are: Other private services_Urban (35), Public services_Urban (36) and Other private services_Rural (17). With this landscape, we can detect the most important links among sectors. This way, Other private services_Urban (35) together with the sector Food industries_Rural (10) registers the most important linkages, because the greatest forward linkage value corresponds to sector 35 and the one for backward linkages is sector 10. In Figure 16 we can identify the most relevant sectors as well as linkages in the economy of Norfolk. Sectors with higher importance in this economy are Other private services_Urban (35), Other manufacturing_Urban (29) and Public services_Urban (36). Regarding the most significant linkages between sectors, we find that Other private services_Urban (35) and Construction_Urban (31) register the most important linkage. The highest forward linkage value corresponds to Other private services_Urban (35) and the one for backward linkages is Construction_Urban (31). In order to finish with cluster 1, Konstanz is represented in Figure 17. Sectors with higher importance in this economy are Other private services_Rural (17), Other manufacturing_Rural (11) and Other private services_Urban (35). With this landscape, we can detect the most important linkages between sectors: Other private services_Rural (17) and Transport and communication_Rural (16) register the most important link, as a result of the greatest forward and backward linkages.

Regarding this cluster, we can highlight that two sectors share leadership within these three regions: Other private services_Urban and Public services_Urban.

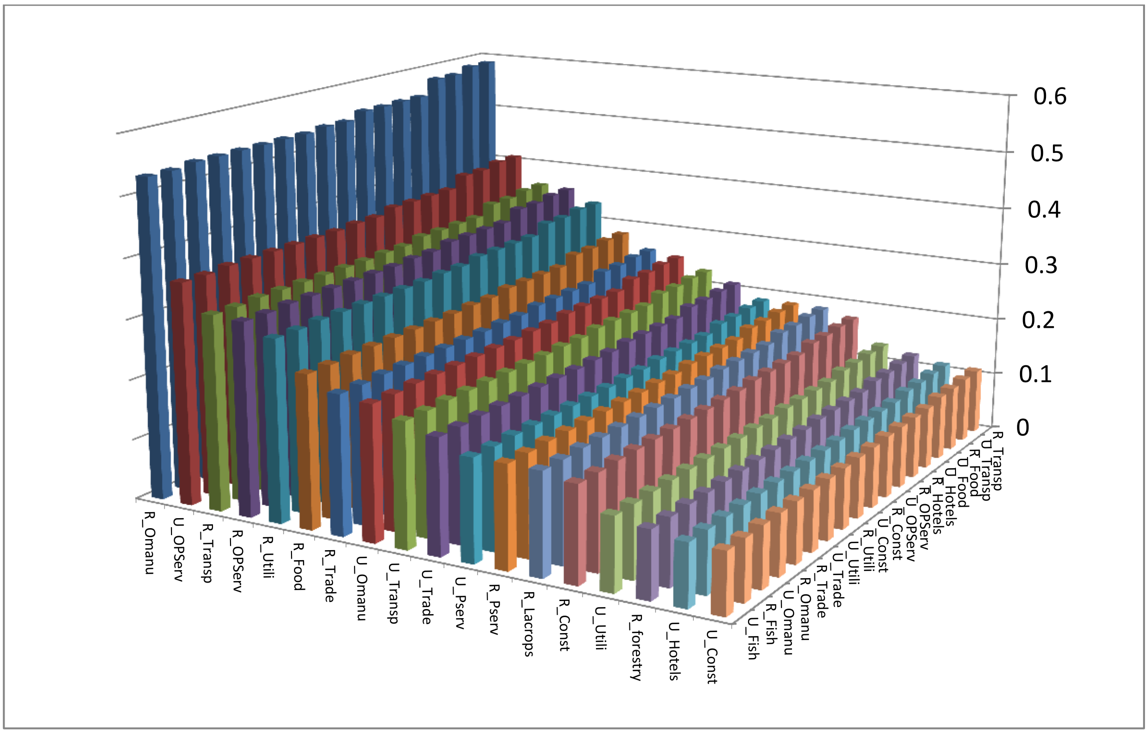
- Cluster 2 (rural areas depending on agriculture with high GDP and accessibility): Gorejnska, Örebro, Noord Drenthe, Finistère.

Figure 18 – Landscape, Gorenjska 2007.



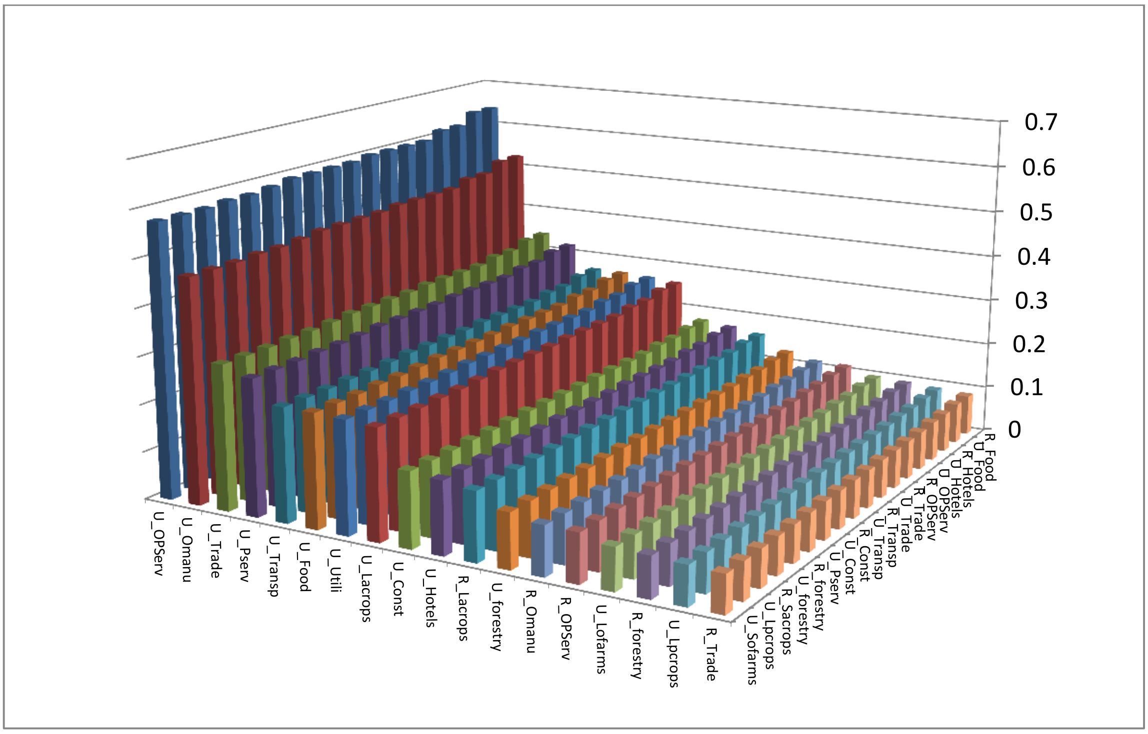
Source: Own elaboration.

Figure 19 – Landscape, Örebro 2007.



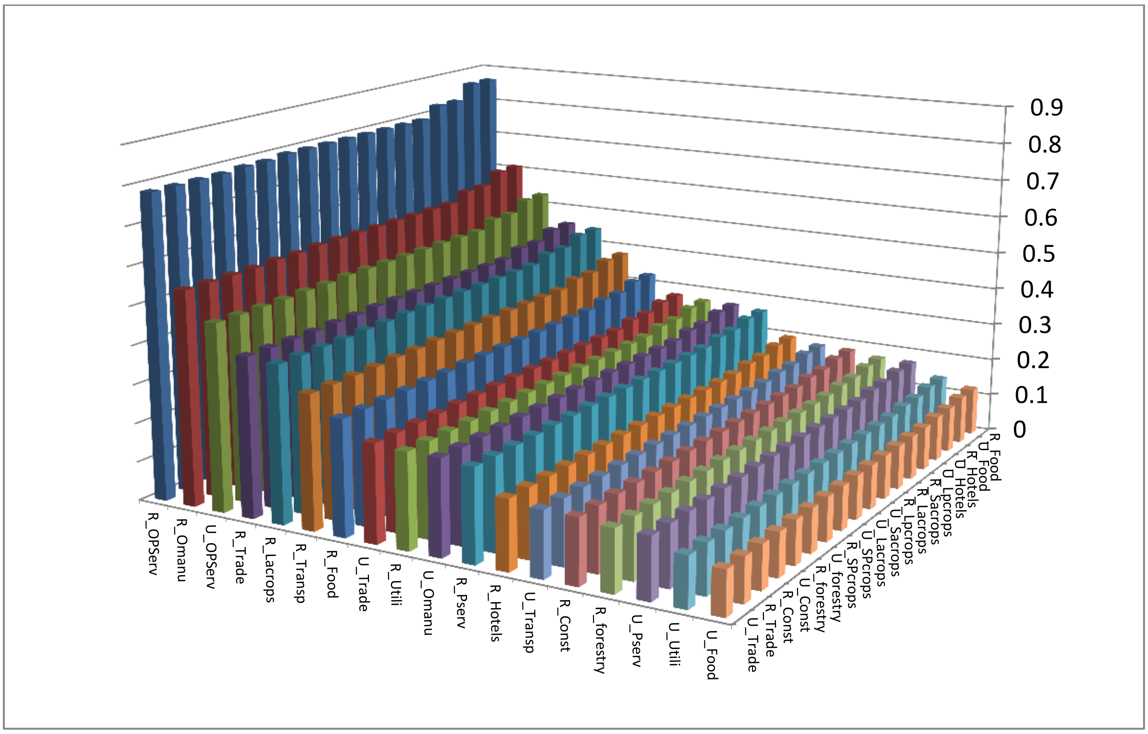
Source: Own elaboration.

Figure 20 – Landscape, Noord Drenthe 2007.



Source: Own elaboration.

Figure 21 – Landscape, Finistère 2007.



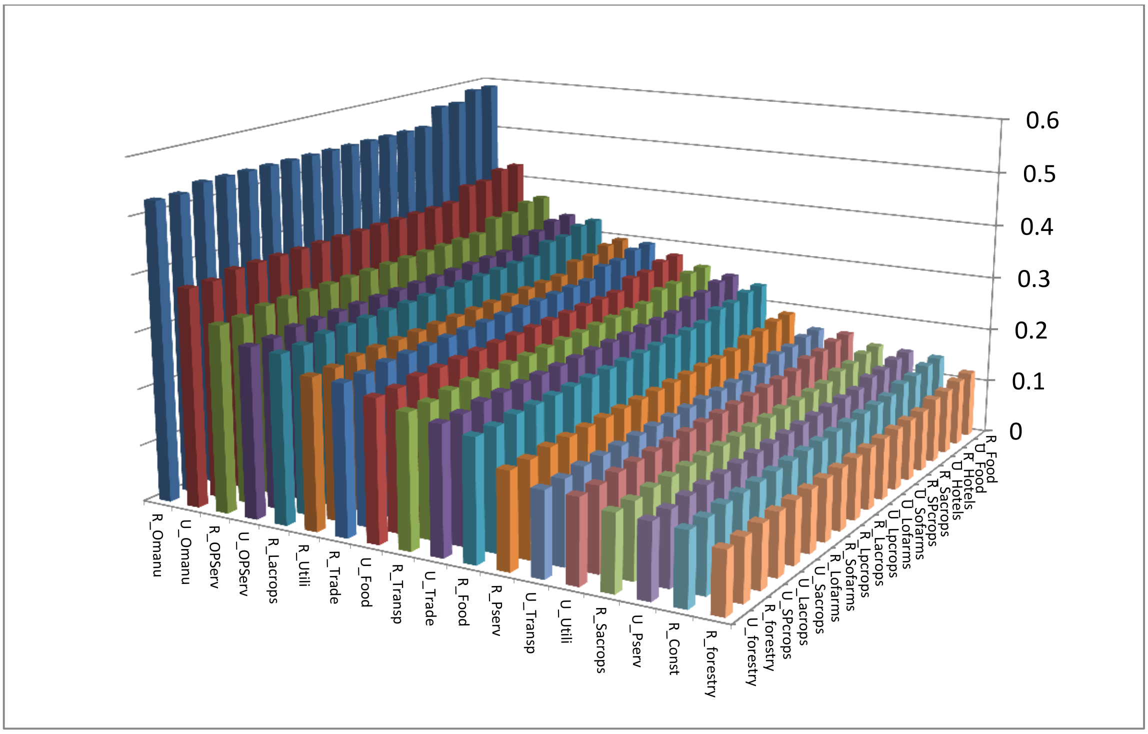
Source: Own elaboration.

Economic landscapes for cluster 2 are presented in Figure 18, 19, 20 and 21. In Figure 18 we can distinguish the most significant sectors and linkages in the economy of Gorenjska. Sectors with higher importance in this economy are Other manufacturing_Rural (11), Trade_Rural (14) and Other private services_Rural (17). With this landscape, we can detect the most important linkages between sectors; so, we can see that Other manufacturing_Rural (11) and Trade_Rural (14) register the most important relationship. The highest forward linkage value corresponds to Other manufacturing_Rural (11) and the one for backward linkages is Trade_Rural (14). Figure 19 shows the information for Örebro. Sectors with higher importance in this economy are the following: Other manufacturing_Rural (11), Other private services_Urban (35) and Transport and communication_Rural (16). With this landscape, we can detect the most important linkage between sectors for Other manufacturing_Rural (11) and Transport and communication_Rural (16). Figure 20 stands for Noord Drenthe. The relevant sectors are Other private services_Urban (35), Other manufacturing_Urban (29) and Trade_Urban (32), as structural path analysis shows. The most important linkage between sectors corresponds with Other private services_Urban (35) and Food industries_Rural (10). In Figure 21, we have the case for Finistère. Sectors with higher importance in this economy are Other private services_Rural (17), Other manufacturing_Rural (11) and Other private services_Urban (35). With this landscape, the most important linkage between sectors can be found between Other private services_Rural (17) with Food industries_Rural (10).

As a summary for this cluster, we can distinguish some similarities regarding the classification of sectors, where three sectors are specially relevant: Other manufacturing_Rural, Other private services_Rural and Other private services_Urban.

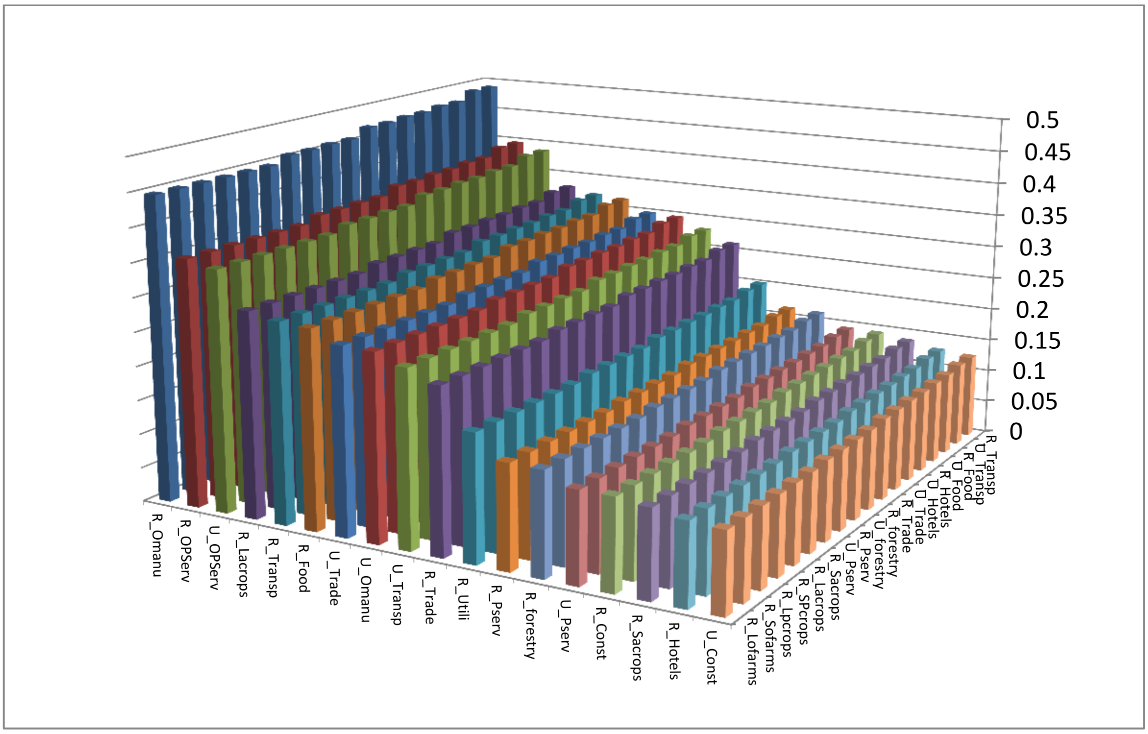
- <u>Cluster 3 (predominantly rural areas with low GDP and low accessibility): Heves, Lääne – Eesti, Slupski.</u>

Figure 22 - Landscape, Heves 2007.



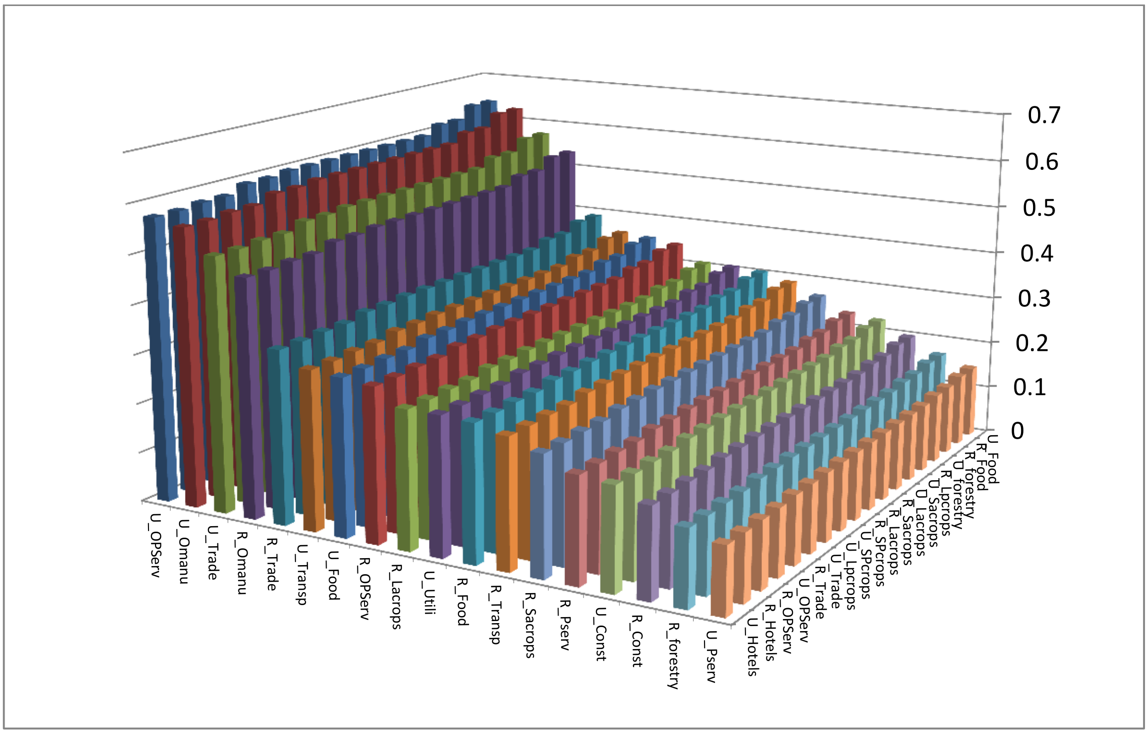
Source: Own elaboration.

Figure 23 - Landscape, Lääne-Eesti 2007.



Source: Own elaboration.

Figure 24 - Landscape, Slupski 2007.



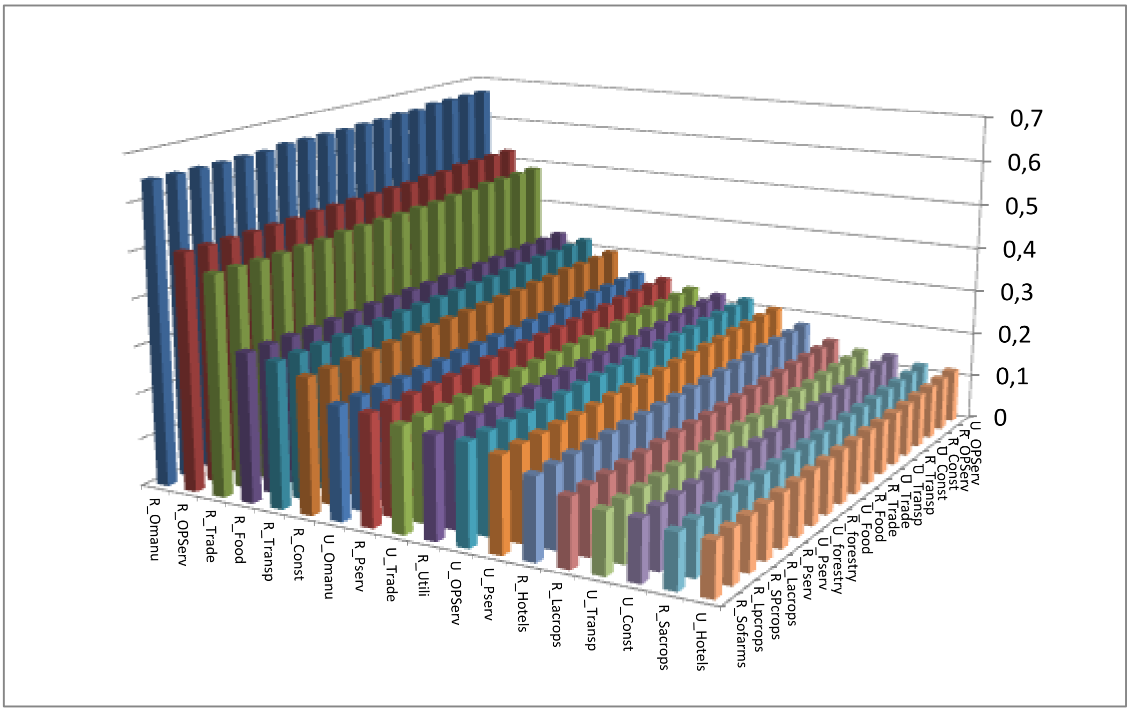
Source: Own elaboration.

Economic landscapes of cluster 3 are presented in Figure 22, 23 and 24. Figure 22 shows the most important sectors and the most important linkages in the economy of Heves. Sectors with higher importance in this economy are Other manufacturing_Rural (11) Other manufacturing_Urban (29) and Other private services_Rural (17). With this landscape, we can detect the most important linkages for Other manufacturing_Rural (11) and Food industries_Rural (10). In Figure 23 we study the case of Lääne-Eesti. Sectors with higher importance in this region are Other manufacturing_Rural (11), Other private services_Rural (17) and Other private services_Urban (35). The sectors Other manufacturing_Rural (11) and Transport and communication_Rural (16) show the highest linkage. In Figure 24 we can identify the relevant sectors for Slupski, following structural path analysis methodology. Sectors with higher importance in this economy are: Other private services_Urban (35), Other manufacturing_Urban (29) and Trade_Urban (32). Other private services_Urban (35) is linked with Food industries_Urban (28).

Finally, in cluster 3 some similarities can be found, being the most relevant sectors: Other manufacturing_Rural, Other private services_Rural and Other private services_Urban.

- <u>Cluster 6 (urban areas with low GDP and intermediate accessibility): Setúbal.</u>

Figure 25 - Landscape, Setúbal 2007.



Source: Own elaboration.

In Figure 25 we can identify the most important sectors and the most important linkages in the economy of Setúbal (cluster 6). Sectors with higher importance following this methodology are Other manufacturing_Rural (11), Other private services_Rural (17) and Trade_Rural (14). With this landscape, we can detect the most important links between sectors; so, we can see that Other manufacturing_Rural (11) and Other private services_Urban (35) register the most important link. The highest forward linkage value corresponds to Other manufacturing_Rural (11) and the one for backward linkages is Other private services_Urban (35).

3.2.4 CAP Impact on NUTS3 regions

3.2.4.1 Background

We have designed an illustrative experiment with SimSIP SAM consisting in exogenously shocking the demand of any combination of endogenous activities in the original SAMs, in order to capture the impact of the Common Agricultural Policy (CAP) in each NUTS3 region for 2007. We propose a counterfactual analysis where we simulate what would have been the performance of the total production of these economies if CAP funds had not been implemented in the regions concerned. Tables 10 and 11 present the amount of EAGF and EAFRD historical shocks implemented between 2007 and 2011. The distribution of funds between accounts has been made taking weights depending on the total output in each NUTS 3 region. We also we present the size of the shock and the corresponding results.

Table 10 - Regional amount and distribution of EAGF 2007-2011. Euros.

	Small arable crops farms	Large arable crops farms	Small permanent crops farms	Large permanent crops farms	Small other farms	Large other farms	Total
Huesca	176.741.452	639.986.572	2.887.577	7.291.147	512.875	316.470	827.736.094
Konstanz	6.903.496	41.639.967	369.742	1.767.800	70.763	70.048	50.821.816
Lüneburg	3.751.364	92.933.264	0	0	472.595	2.077.876	99.235.099
Noord Drenthe	2.786.171	124.938.432	0	2.496	473.247	6.638.855	99.235.099
Heves	46.860.952	141.505.014	64.881	2.108.637	992.935	937.678	192.470.097
Slupski	56.658.367	68.626.339	691.368	22.469.452	0	0	148.445.526
Lääne-Eesti	11.755.028	39.795.735	9.899	321.721	38.855	7.819	51.929.057
Gorenjska	9.742.494	6.529.422	1.941	63.075	6.905	541	16.344.378
Setúbal	17.448.113	25.293.205	2.684.822	5.409.866	112.124	80.420	51.028.549
Finistère	18.505.317	482.578.069	11.581.155	65.544.407	0		578.208.948
Örebro	10.474.228	36.912.840	14.518	471.834	45.385	59.420	47.978.224
Norfolk	14.281.426	487.867.772	8.556	215.111	5.637.512	20.651.136	528.661.514

Source: Own elaboration.

Table 11 - Regional amount and distribution of EAFRD 2007-2011. Euros.

	Food industries	Other manufacturing	Construction	Trade	Hotels and restaurants	Transport and communication	Other private services	Public services	Households (rural)	Total
Huesca	0	16.764.383	15.826.111	0	286.595	2.409.793	20.503.589	18.478.680	6.916.996	81.186.149
Konstanz	0	2.565.027	554.232	36.467	5.505	766.114	3.333.378	1.437.322	1.323.220	10.021.266
Lüneburg	0	5.791.121	1.426.879	8.087	43.341	1.729.674	7.079.045	3.168.644	893.968	20.144.652
Noord Drenthe	0	1.452.496	483.553	6.130	808.750	433.827	2.325.993	1.333.157	18.820	6.862.726
Heves	46.433	15.914.850	2.826.442	51.340	226.118	2.823.493	9.703.885	7.139.804	1.691.060	40.423.423
Slupski	138.018	23.027.239	6.691.652	227.521	16.402	6.358.501	15.054.650	12.527.538	39.156.159	103.197.682
Lääne-Eesti	278.211	22.713.817	8.247.413	354.080	62.282	8.529.413	15.316.911	9.460.022	13.073.125	78.035.275
Gorenjska	8.992	4.532.207	627.398	14.358	2.717	767.463	1.657.531	913.997	10.369.732	18.894.396
Setúbal		2.236.659	725.958	0	0	609.049	2.300.770	2.273.482	228.067	8.373.984
Finistère	378	5.398.841	1.988.891	734	147	1.950.166	7.220.109	5.932.111	471.863	22.963.241
Örebro	20.541	3.726.462	720.520	50.729	103.911	1.475.824	3.371.339	2.622.854	2.112.773	14.204.951
Norfolk	8.562	12.380.069	7.119.492	23.547	125.089	6.957.309	20.757.911	15.900.899	9.901	63.282.780

Source: Own elaboration

3.2.4.2 Impact in production and GDP in NUTS 3 regions

- Cluster 5 (Rural areas strongly dependent on agriculture with low GDP and accessibility): Huesca.

Table 12 presents the results for Huesca (cluster 5) aggregating the agricultural sector. We can see that the loss in the aggregated impact in production/income when we detract the CAP is around 425 million Euros, approximately a 3.9 per cent over its total income.

Table 12 - Total Impact in production / Income for Huesca. Million Euros.

	SAM Accounts	Total impact in production/income
Activities		
1	R_Agri	-100.15
2	R_Forestry	-0.47
3	R_Fish	-0.13
4	R_Mining	-2.02
5	R_Food	-39.03
6	R_Omanu	-39.32
7	R_Utili	-3.54
8	R_Const	-23.37
9	R_Trade	-11.90
10	R_Hotels	-11.08
11	R_Transp	-8.79
12	R_Opserv	-25.82
13	R_Pserv	-4.56
14	U_Agri	-114.63
15	U_Forestry	-0.03
16	U_Fish	-0.01
17	U_Mining	-0.12
18	U_Food	-2.37
19	U_Omanu	-9.74
20	U_Utili	-0.69
21	U_Const	-6.85
22	U_Trade	-4.36
23	U_Hotels	-2.83
24	U_Transp	-1.98
25	U_Opserv	-9.48

26	U_Pserv	-1.14
Commodities		
27	C_Agri	-69.20
28	C_forestry	-0.75
29	C_Fish	-0.20
30	C_Mining	-3.02
31	C_Food	-61.48
32	C_Omanu	-80.97
33	C_Utili	-7.12
34	C_Const	-30.59
35	C_Trade	-19.52
36	C_Hotels	-25.00
37	C_Transp	-12.17
38	C_OPServ	-40.15
39	C_Pserv	-4.39
40	S_Labour	-33.91
41	U_Labour	-8.13
42	Capital	-120.09
43	Enterprises	-41.99
44	R_Households	-40.10
45	U_Households	-99.34
	Aggregate	-424.39[14]

Source: Own elaboration.

- <u>Cluster 1 (intermadiate urban/rural areas, economically diversified with high GDP and accessibility): Lüneburg, Norfolk, Konstanz.</u>

The total impacts in production for cluster 1 are presented in Tables 13, 14 and 15 aggregating the agricultural sector. In Table 13, we present the results for Lüneburg. In this case, note that the loss in the aggregate impact in production/income when we detract the CAP is 32.5 million Euros, approximately a 0.5 per cent of its total income. In Table 14, we develop the impact analysis for Norfolk. In this case, we observe that the loss in the aggregate impact in production/income when we detract the CAP is around 253 million Euros, approximately a 0.8 per cent of its income; and in Table 15, we present the results for Konstanz and the loss when we detract the CAP is around 30 million Euros, approximately a 0.2 per cent of its income. The first two regions seem to be slightly more sensitive than the third one to the removal of agricultural funding; however, the impact of removing CAP on these economies remains moderate (below 1% of their total income).

[14] The total is the sum of activities (from 1 to 26).

Table 13 - Total Impact in production / income for Lüneburg. Millions Euros.

	SAM Accounts	Total impact in production/income
Activities		
1	R_Agri	-9.50
2	R_Forestry	-0.05
3	R_Fish	0.00
4	R_Mining	-0.05
5	R_Food	-0.96
6	R_Omanu	-1.44
7	R_Utili	-0.87
8	R_Const	-0.35
9	R_Trade	-1.01
10	R_Hotels	-0.13
11	R_Transp	-0.92
12	R_Opserv	-3.20
13	R_Pserv	-0.52
14	U_Agri	-1.36
15	U_Forestry	-0.01
16	U_Fish	0.00
17	U_Mining	-0.01
18	U_Food	-0.19
19	U_Omanu	-2.05
20	U_Utili	-0.24
21	U_Const	-0.26
22	U_Trade	-1.17
23	U_Hotels	-0.21
24	U_Transp	-0.88
25	U_Opserv	-3.99
26	U_Pserv	-3.12
Commodities		
27	C_Agri	-0.82
28	C_Forestry	-0.06
29	C_Fish	-0.01
30	C_Mining	-0.37
31	C_Food	-1.44

32	C_Omanu	-4.69
33	C_Utili	-1.25
34	C_Const	-0.63
35	C_Trade	-2.45
36	C_Hotels	-0.37
37	C_Transp	-2.02
38	C_Opserv	-7.91
39	C_Pserv	-3.64
40	S_Labour	-7.77
41	U_Labour	-1.53
42	Capital	-7.34
43	Enterprises	-4.81
44	R_Households	-3.98
45	U_Households	-10.51
	Aggregate	-32.50

Source: Own elaboration.

Table 14 - Total Impact in production / income for Norfolk. Millions Euros.

	SAM Accounts	Total impact in production/income
Activities		
1	R_Agri	-62.42
2	R_Forestry	-0.07
3	R_Fish	-0.09
4	R_Mining	-0.44
5	R_Food	-1.56
6	R_Omanu	-9.04
7	R_Utili	-2.30
8	R_Const	-2.40
9	R_Trade	-7.95
10	R_Hotels	-1.19
11	R_Transp	-7.18
12	R_Opserv	-9.83
13	R_Pserv	-9.50
14	U_Agri	-54.08
15	U_Forestry	-0.06
16	U_Fish	-0.08
17	U_Mining	-1.85

18	U_Food	-6.59
19	U_Omanu	-12.76
20	U_Utili	-3.65
21	U_Const	-3.26
22	U_Trade	-11.40
23	U_Hotels	-1.60
24	U_Transp	-5.68
25	U_Opserv	-23.64
26	U_Pserv	-13.88
Commodities		
27	C_Agri	-16.40
28	C_Forestry	-0.13
29	C_Fish	-0.24
30	C_Mining	-3.44
31	C_Food	-12.34
32	C_Omanu	-32.68
33	C_Utili	-9.24
34	C_Const	-5.73
35	C_Trade	-20.28
36	C_Hotels	-4.10
37	C_Transp	-14.89
38	C_Opserv	-38.85
39	C_Pserv	-9.62
40	S_Labour	-69.80
41	U_Labour	-16.62
42	Capital	-26.98
43	Enterprises	-5.39
44	R_Households	-43.11
45	U_Households	-49.81
	Aggregate	-252.47

Source: Own elaboration.

Table 15 - Total Impact in production / income for Konstanz. Millions Euros.

	SAM Accounts	Total impact in production/income
Activities		
1	R_Agri	-4.20
2	R_Forestry	-0.04
3	R_Fish	0.00
4	R_Mining	-0.07
5	R_Food	-1.39
6	R_Omanu	-3.06
7	R_Utili	-1.14
8	R_Const	-0.30
9	R_Trade	-1.33
10	R_Hotels	-0.18
11	R_Transp	-1.07
12	R_Opserv	-4.04
13	R_Pserv	-1.45
14	U_Agri	-6.76
15	U_Forestry	0.00
16	U_Fish	0.00
17	U_Mining	-0.01
18	U_Food	-0.15
19	U_Omanu	-1.11
20	U_Utili	-0.39
21	U_Const	-0.09
22	U_Trade	-0.74
23	U_Hotels	-0.11
24	U_Transp	-0.45
25	U_Opserv	-1.85
26	U_Pserv	-0.29
Commodities		
27	C_Agri	-0.68
28	C_Forestry	-0.05
29	C_Fish	0.00
30	C_Mining	-0.42
31	C_Food	-1.91
32	C_Omanu	-5.36
33	C_Utili	-1.72

34	C_Const	-0.39
35	C_Trade	-2.32
36	C_Hotels	-0.31
37	C_Transp	-1.68
38	C_Opserv	-6.43
39	C_Pserv	-1.74
40	S_Labour	-5.66
41	U_Labour	-1.21
42	Capital	-7.82
43	Enterprises	-5.89
44	R_Households	-2.03
45	U_Households	-10.83
	Aggregate	-30.22

Source: Own elaboration.

- Cluster 2 (rural areas depending on agriculture with high GDP and accessibility) : Gorejnska, Örebro, Noord Drenthe, Finistère.

The total impacts in production for cluster 2 are presented in Tables 16, 17, 18 and 19 aggregating the agricultural sector. In Table 16, we develop the impact analysis for Gorenjska. In this case, we observe that the loss in the aggregate impact in production/income when we detract the CAP is around 10 million Euros, approximately a 0.1 per cent of its income. In Table 17, we present the results for Örebro; in this case, note that the loss in the aggregate impact in production/income is around 24 million Euros, approximately a 0.1 per cent of its income. In Table 18, we present the results for Noord Drenthe. The loss in the aggregate impact in production/income when we detract the CAP is around 55 million Euros, around a 0.5 per cent of its income. And finally, in Table 19, we present the results for Finistère and we can point out that the loss in the aggregated impact in production/income when we detract the CAP is around 300 million Euros, approximately a 0.8 per cent. Looking at the results, we can find two different behaviours when assessing the removal of funds. The first two regions seem to be less affected than the other two. The region of Finistère registers the highest fall as a result of the counterfactual analysis. Similarly to cluster 1, the removing of CAP funds would have a limited impact 1% of the total regional income.

Table 16 - Total Impact in production / income for Gorenjska. Millions Euros.

	SAM Accounts	Total impact in production/income
Activities		
1	R_Agri	-3.62
2	R_Forestry	-0.02
3	R_Fish	0.00

4	R_Mining	-0.02
5	R_Food	-0.40
6	R_Omanu	-1.27
7	R_Utili	-0.30
8	R_Const	-0.23
9	R_Trade	-0.70
10	R_Hotels	-0.14
11	R_Transp	-0.47
12	R_Opserv	-0.70
13	R_Pserv	-0.37
14	U_Agri	0.00
15	U_Forestry	0.00
16	U_Fish	0.00
17	U_Mining	0.00
18	U_Food	0.00
19	U_Omanu	-0.26
20	U_Utili	-0.05
21	U_Const	-0.09
22	U_Trade	-0.24
23	U_Hotels	-0.02
24	U_Transp	-0.12
25	U_Opserv	-0.49
26	U_Pserv	-0.06
Commodities		
27	C_Agri	-0.99
28	C_Forestry	-0.02
29	C_Fish	0.00
30	C_Mining	-0.11
31	C_Food	-0.91
32	C_Omanu	-3.75
33	C_Utili	-0.85
34	C_Const	-0.31
35	C_Trade	-1.04
36	C_Hotels	-0.23
37	C_Transp	-0.73
38	C_Opserv	-1.53
39	C_Pserv	-0.40

40	S_Labour	-1.02
41	U_Labour	-0.17
42	Capital	-2.09
43	Enterprises	-0.43
44	R_Households	-4.13
45	U_Households	-0.77
	Aggregate	-9.59

Source: Own elaboration.

Table 17 - Total Impact in production / income for Örebro. Millions Euros.

	SAM Accounts	Total impact in production/income
Activities		
1	R_Agri	-9.16
2	R_Forestry	-0.08
3	R_Fish	0.00
4	R_Mining	-0.11
5	R_Food	-0.91
6	R_Omanu	-2.49
7	R_Utili	-0.90
8	R_Const	-0.44
9	R_Trade	-0.80
10	R_Hotels	-0.10
11	R_Transp	-1.02
12	R_Opserv	-1.17
13	R_Pserv	-0.64
14	U_Agri	-1.57
15	U_Forestry	-0.01
16	U_Fish	0.00
17	U_Mining	-0.01
18	U_Food	-0.08
19	U_Omanu	-0.89
20	U_Utili	-0.24
21	U_Const	-0.20
22	U_Trade	-0.62
23	U_Hotels	-0.10
24	U_Transp	-0.58
25	U_Opserv	-1.38

26	U_Pserv	-0.64
Commodities		
27	C_Agri	-1.60
28	C_Forestry	-0.11
29	C_Fish	-0.02
30	C_Mining	-0.52
31	C_Food	-1.54
32	C_Omanu	-4.94
33	C_Utili	-1.54
34	C_Const	-0.63
35	C_Trade	-1.65
36	C_Hotels	-0.22
37	C_Transp	-1.90
38	C_Opserv	-3.21
39	C_Pserv	-1.20
40	S_Labour	-4.09
41	U_Labour	-0.55
42	Capital	-5.37
43	Enterprises	-2.71
44	R_Households	-4.67
45	U_Households	-4.03
	Aggregate	-24.15

Source: Own elaboration.

Table 18 - Total Impact in production / income for Noord Drenthe. Millions Euros.

	SAM Accounts	Total impact in production/income
Activities		
1	R_Agri	-11.04
2	R_Forestry	-0.01
3	R_Fish	-0.01
4	R_Mining	-0.01
5	R_Food	-0.27
6	R_Omanu	-0.55
7	R_Utili	0.00
8	R_Const	-0.03
9	R_Trade	-0.22

10	R_Hotels	-0.04
11	R_Transp	-0.11
12	R_Opserv	-0.41
13	R_Pserv	0.00
14	U_Agri	-22.07
15	U_Forestry	-0.03
16	U_Fish	-0.03
17	U_Mining	-0.05
18	U_Food	-2.46
19	U_Omanu	-4.82
20	U_Utili	-1.33
21	U_Const	-0.30
22	U_Trade	-2.33
23	U_Hotels	-0.51
24	U_Transp	-1.19
25	U_Opserv	-4.53
26	U_Pserv	-1.86
Commodities		
27	C_Agri	-8.04
28	C_Forestry	-0.05
29	C_Fish	-0.10
30	C_Mining	-1.22
31	C_Food	-4.23
32	C_Omanu	-10.33
33	C_Utili	-3.00
34	C_Const	-0.33
35	C_Trade	-2.66
36	C_Hotels	-0.56
37	C_Transp	-1.67
38	C_Opserv	-5.56
39	C_Pserv	-1.77
40	S_Labour	-6.18
41	U_Labour	-0.94
42	Capital	-13.19
43	Enterprises	-8.67
44	R_Households	-8.46
45	U_Households	-4.64

Aggregate	-54.23

Source: Own elaboration.

Table 19 – Total Impact in production / income for Finistère. Millions Euros.

	SAM Accounts	Total impact in production/income
Activities		
1	R_Agri	-138.46
2	R_Forestry	-0.33
3	R_Fish	-0.26
4	R_Mining	-0.31
5	R_Food	-12.29
6	R_Omanu	-21.76
7	R_Utili	-5.83
8	R_Const	-2.21
9	R_Trade	-14.40
10	R_Hotels	-3.02
11	R_Transp	-9.23
12	R_Opserv	-27.65
13	R_Pserv	-6.46
14	U_Agri	-10.74
15	U_Forestry	-0.03
16	U_Fish	-0.02
17	U_Mining	-0.07
18	U_Food	-2.82
19	U_Omanu	-8.24
20	U_Utili	-2.18
21	U_Const	-0.90
22	U_Trade	-7.91
23	U_Hotels	-1.08
24	U_Transp	-3.54
25	U_Opserv	-16.17
26	U_Pserv	-3.53
Commodities		
27	C_Agri	-37.07
28	C_Forestry	-0.39
29	C_Fish	-0.44
30	C_Mining	-3.66

31	C_Food	-20.09
32	C_Omanu	-43.86
33	C_Utili	-14.14
34	C_Const	-3.12
35	C_Trade	-22.74
36	C_Hotels	-4.17
37	C_Transp	-14.30
38	C_Opserv	-46.48
39	C_Pserv	-9.29
40	S_Labour	-61.06
41	U_Labour	-3.68
42	Capital	-70.06
43	Enterprises	-33.07
44	R_Households	-77.97
45	U_Households	-38.14
	Aggregate	-299.45

Source: Own elaboration.

- Cluster 3 (predominantly rural areas with low GDP and low accessibility) : Heves, Lääne – Eesti, Slupski.

The results for cluster 3 are presented in Tables 20, 21 and 22. In Table 20, we present the results for Heves where the loss when we detract the CAP is around 99 million Euros, approximately a 1.8 per cent of its income. In Table 21, we present the results for Lääne-Eesti, loosing around 45 million Euros, around a 1.5 per cent of its income. In Table 22, we present the results for Slupski aggregating the agricultural sector, as in the previous regions. In this case, note that the loss is around 50 million Euros, approximately a 2 per cent of its income. The removal of funds in cluster 3 regions generates an important multiplier effect of a 1.8% of income reduction in average terms.

Table 20 - Total Impact in production / income for Heves. Millions Euros.

	SAM Accounts	Total impact in production/income
Activities		
1	R_Agri	-39.91
2	R_Forestry	-0.12
3	R_Fish	-0.01
4	R_Mining	-0.08
5	R_Food	-3.27
6	R_Omanu	-8.71
7	R_Utili	-2.50

8	R_Const	-0.93
9	R_Trade	-3.32
10	R_Hotels	-0.39
11	R_Transp	-2.55
12	R_Opserv	-4.37
13	R_Pserv	-2.19
14	U_Agri	-8.90
15	U_Forestry	-0.03
16	U_Fish	0.00
17	U_Mining	-0.10
18	U_Food	-4.00
19	U_Omanu	-6.09
20	U_Utili	-1.11
21	U_Const	-0.48
22	U_Trade	-2.70
23	U_Hotels	-0.32
24	U_Transp	-1.34
25	U_Opserv	-3.92
26	U_Pserv	-1.46
Commodities		
27	C_Agri	-10.92
28	C_Forestry	-0.12
29	C_Fish	-0.01
30	C_Mining	-2.15
31	C_Food	-9.77
32	C_Omanu	-23.47
33	C_Utili	-5.51
34	C_Const	-1.53
35	C_Trade	-5.98
36	C_Hotels	-0.75
37	C_Transp	-4.56
38	C_Opserv	-10.44
39	C_Pserv	-3.63
40	S_Labour	-14.71
41	U_Labour	-3.29
42	Capital	-22.68
43	Enterprises	-5.39

44	R_Households	-25.81
45	U_Households	-10.40
	Aggregate	-98.79

Source: Own elaboration.

Table 21 - Total Impact in production / income for Lääne-Eesti. Millions Euros.

	SAM Accounts	Total impact in production/income
Activities		
1	R_Agri	-11.27
2	R_Forestry	-0.47
3	R_Fish	-0.07
4	R_Mining	-0.22
5	R_Food	-1.70
6	R_Omanu	-4.60
7	R_Utili	-0.89
8	R_Const	-1.34
9	R_Trade	-1.39
10	R_Hotels	-0.34
11	R_Transp	-2.38
12	R_Opserv	-3.55
13	R_Pserv	-1.63
14	U_Agri	-2.37
15	U_Forestry	-0.10
16	U_Fish	-0.01
17	U_Mining	-0.04
18	U_Food	-0.28
19	U_Omanu	-2.54
20	U_Utili	-0.30
21	U_Const	-1.07
22	U_Trade	-1.64
23	U_Hotels	-0.26
24	U_Transp	-2.02
25	U_Opserv	-3.45
26	U_Pserv	-1.31
Commodities		
27	C_Agri	-4.02
28	C_Forestry	-0.72

29	C_Fish	-0.11
30	C_Mining	-0.45
31	C_Food	-3.32
32	C_Omanu	-13.98
33	C_Utili	-3.02
34	C_Const	-2.30
35	C_Trade	-3.14
36	C_Hotels	-0.69
37	C_Transp	-5.19
38	C_Opserv	-8.49
39	C_Pserv	-2.85
40	S_Labour	-7.80
41	U_Labour	-1.98
42	Capital	-9.83
43	Enterprises	-4.48
44	R_Households	-13.12
45	U_Households	-5.75
	Aggregate	-45.23

Source: Own elaboration.

Table 22 - Total Impact in production / income for Slupski. Millions Euros.

	SAM Accounts	Total impact in production/income
Activities		
1	R_Agri	-33.36
2	R_Forestry	-0.33
3	R_Fish	-0.02
4	R_Mining	-0.62
5	R_Food	-3.74
6	R_Omanu	-8.24
7	R_Utili	-0.82
8	R_Const	-2.14
9	R_Trade	-5.02
10	R_Hotels	-0.56
11	R_Transp	-3.44
12	R_Opserv	-4.98
13	R_Pserv	-3.77
14	U_Agri	-8.40

15	U_Forestry	-0.08
16	U_Fish	-0.01
17	U_Mining	-0.75
18	U_Food	-4.49
19	U_Omanu	-9.82
20	U_Utili	-3.28
21	U_Const	-2.58
22	U_Trade	-7.82
23	U_Hotels	-0.42
24	U_Transp	-4.49
25	U_Opserv	-10.18
26	U_Pserv	-1.89
Commodities		
27	C_Agri	-14.37
28	C_Forestry	-0.44
29	C_Fish	-0.11
30	C_Mining	-3.31
31	C_Food	-10.11
32	C_Omanu	-30.76
33	C_Utili	-8.37
34	C_Const	-4.92
35	C_Trade	-12.07
36	C_Hotels	-1.05
37	C_Transp	-9.27
38	C_Opserv	-17.08
39	C_Pserv	-5.90
40	S_Labour	-13.57
41	U_Labour	-1.86
42	Capital	-33.81
43	Enterprises	-5.10
44	R_Households	-36.65
45	U_Households	-16.87
	Aggregate	-121.27

Source: Own elaboration.

- Cluster 6 (urban areas with low GDP and intermediate accessibility): Setúbal.

In Table 23, the results for Setúbal are outlined. In this case, the reduction in terms of the aggregate impact in production/income when we detract the CAP is around 26 million Euros, a modest 0.1 per cent of the total regional income.

Table 23 – Total Impact in production / income for Setúbal. Millions Euros.

	SAM Accounts	Total impact in production/income
Activities		
1	R_Agri	-10.80
2	R_Forestry	-0.07
3	R_Fish	-0.03
4	R_Mining	-0.06
5	R_Food	-1.40
6	R_Omanu	-2.43
7	R_Utili	-0.50
8	R_Const	-0.83
9	R_Trade	-1.83
10	R_Hotels	-0.31
11	R_Transp	-0.87
12	R_Opserv	-1.73
13	R_Pserv	-0.80
14	U_Agri	-0.20
15	U_Forestry	0.00
16	U_Fish	0.00
17	U_Mining	-0.01
18	U_Food	-0.22
19	U_Omanu	-0.77
20	U_Utili	-0.07
21	U_Const	-0.26
22	U_Trade	-0.74
23	U_Hotels	-0.16
24	U_Transp	-0.26
25	U_Opserv	-0.61
26	U_Pserv	-0.64
Commodities		
27	C_Agri	-1.77
28	C_Forestry	-0.06

29	C_Fish	-0.03
30	C_Mining	-0.43
31	C_Food	-2.71
32	C_Omanu	-5.07
33	C_Utili	-1.08
34	C_Const	-1.05
35	C_Trade	-2.64
36	C_Hotels	-0.46
37	C_Transp	-1.28
38	C_Opserv	-2.70
39	C_Pserv	-1.19
40	S_Labour	-5.28
41	U_Labour	-0.62
42	Capital	-4.23
43	Enterprises	-3.13
44	R_Households	-2.95
45	U_Households	-6.25
	Aggregate	-25.60

Source: Own elaboration.

In general, regions of clusters 5 and 3, the most depending on agriculture and with the lowest GDP and accessibility, would be more affected than other regions, even rural ones.

Finally Table 24 outlines how the production falls in euros per each euro that is detracted from each economy. In other words, if we decrease the CAP policy by 1 euro, the budget multiplier gives the decrease in output in euros. In table 24 we can see that the NUTS 3 region with the higher multiplier is Finistère with 2.49 which we interpret as, for each euro that is removed in the NUTS 3 economy from CAP aid, the total loss in production is 2.49 euros. On the other hand, the NUTS 3 region with the lowest budget multiplier is Gorenjska with a multiplier of 1.41. In general terms, it is difficult to see any result across clusters. One potential reason is that regions may be dependent on the level of funding.

Table 24 - Budget Multipliers

Cluster	NUTS 3	Budget Multipliers
Cluster 5	Huesca	2.33
Cluster 1	Lüneburg	2.27
	Norfolk	2.13
	Konstanz	2.42
Cluster 2	Gorenjska	1.41
	Örebro	1.94

	Noord Drenthe	1.92
	Finistère	2.49
Cluster 3	Heves	2.12
	Lääne - Eesti	1.74
	Slupski	2.41
Cluster 6	Setúbal	2.22

Source: Own elaboration.

4 An approach for obtaining 'automatic' SAMs at NUTS3 level and comparative assessment of ‘automatic’ and ‘expert’ SAMS

4.1 Introduction

In this section we present three non-expert (automatic) NUTS3 SAMs as a solution which can be envisaged in order to regionalise at NUTS 3 level when we there is not enough information or as a first approach before building a more accurate database. We use data at NUTS2 (Aragon) and NUTS1 level (Baden-Württemberg and Niedersachsen). Regionalisation and balancing procedures proposed are further documented. In short, we propose to use provincial GDP, and other macroeconomic indicators, e.g. total output, to obtain the SAM at NUTS 3 from a more aggregated database, following Cardenete and Sancho (2004).

4.2 Description of mechanical procedure

To develop this procedure, that can be useful as a simple tool for regionalisation, we tested the use of the RAS updating technique (described above in section 2.2.1), technique which has been traditionally used to estimate input output tables with minimum data requirements based on intermediate demand, total intermediate consumption and year of the estimation. In addition, we propose to use the Cross Entropy Method described in section 2.2.2. above. Entropy methods have been adapted by Golan, Judge and Robinson (1994), Thissen and Lofgren (1999), Robinson, Cattaneo and El-Said (2001).

The Cross-Entropy approach involves projecting technical coefficients instead of total SAM flows. Once the new coefficients have been obtained, the new SAM can be derived in the usual way. Because Cross Entropy directly aims at estimating technical coefficients, the scaling method does not work. The problem would consist of the following minimisation problem:

$$d(A^0, \hat{A}^1) = \sum_{i=1}^{n} \sum_{j=1}^{n} (\hat{a}_{ij}^1/X_j).(\ln(\hat{a}_{ij}^1/X_j) - \ln(\hat{a}_{ij}^0/X_j^0)) \qquad (5)$$

s.t.

$$\sum_{j=1}^{n} \hat{a}_{ij}^1 = X_i \text{ for all } i$$

$$a_{ij}^0 = 0 \text{ implies } \hat{a}_{ij}^1 = 0$$

where $A=(a_{ij})$ represent a matrix in the set An of the *nxn* non-negative matrices that have no zero row or column. Considering now a matrix $A_0 \in A_n$ a positive vector $X \in R_+^n$ [15], and a

[15] Positive natural numbers

loss function $d: A_n \times A_n \rightarrow R$. $X_j^0 = \Sigma_i a_{ij}^0$ is the level value for the *jth* row and column sum in the original matrix, and a_{ij}^0 / X_j^0 and $\hat{a}_{ij}^0 / X_j$ initial and updated technical coefficients, respectively.

This methodology has been applied in this project to regionalise SAMs NUTS2 and the following minimum requirements have been introduced for each region:

1. Well-known prior matrix –NUTS2- built by experts and previous IPTS works.
2. Totals by rows or columns (marginal) in the new base region NUTS3;
3. And Gross Domestic Product structure –income and expenditure- for the new region NUTS3.

4.3 Comparative analysis

The methodology of Cardenete and Sancho (2004) is tested for three NUTS2 areas corresponding to previous IPTS work (Aragón, Baden-Württemberg and Niedersachsen) by Müller and Ferrari (2013). We analyse these economies with different indicators (key sectors and Le Masné Index). The index that is used to analyse the changes in technical coefficients has been used in several studies, e.g. Antille, Fontela, Guillet (2000), Soza-Amigo (2009), Cardenete and Lopez (2012), Cardenete, Congregado, de Miguel and Perez (2000). Social Accounting Matrices have been aggregated to make possible the comparison between procedures, aggregating accounts to build homogeneous structures. So, the new structure of these matrices is:

Table 25 -New structure of NUTS3 SAMs.

aAGR	Agriculture	cMAN	Other manufacturing
aFOR	Forestry	cENE	Energy products
aOPP	Other primary production	cCNS	Construction
aFOP	Food processing	cTTR	Trade and Transport
aMAN	Other manufacturing	cHOT	Hotels and Restaurants
aENE	Energy products	cSERV	Servicies
aCNS	Construction	LABOR	Labour
aTTR	Trade and Transport	CAPITAL	Capital
aHOT	Hotels and Restaurants	LAND	Land
aSERV	Services	HOUS	Households
cAGR	Agriculture	TAX_LESS_SUB	Tax less subsidies
cFOR	Forestry	GOV	Government
cOPP	Other primary production	INV	Investment
cFOP	Food processing	ROW	Rest of the world

Source: Own elaboration.

4.3.1 Key sectors from the SAM at NUTS3

Below we present the backward and forward linkages and key sectors for each comparative NUTS3 with an automatic procedure versus an expert procedure. In this case, the concept of key sectors has been relaxed, being defined as key, those sectors with a BL or FL greater than 0.9.

Table 26 - Key sectors for Huesca. Expert procedure vs. Automatic procedure.

	EXPERT PROCEDURE		AUTOMATIC PROCEDURE		VARIATION RATES Absolute values (%)	
	Backward Linkages	Forward Linkages	Backward Linkages	Forward Linkages	Backward Linkages	Forward Linkages
aAGR	1.088	0.904	1.193	0.603	8,83	50,04
aFOR	1.088	0.307	1.158	0.319	6,05	3,73
aOPP	0.995	0.392	0.993	0.309	0,23	27,01
aFOP	1.119	0.819	1.223	0.772	8,45	6,11
aMAN	0.995	1.021	1.073	1.159	7,29	11,91
aENE	1.168	0.417	1.015	0.518	15,02	19,48
aCNS	1.265	1.142	1.127	0.593	12,24	92,64
aTTR	1.069	0.993	1.100	1.138	2,83	12,79
aHOT	1.023	0.622	1.133	0.802	9,70	22,36
aSERV	1.111	1.218	1.071	1.419	3,74	14,16

Source: Own elaboration.

Table 27 - Key sectors for Konstanz. Expert procedure vs. Automatic procedure.

	EXPERT PROCEDURE		AUTOMATIC PROCEDURE		VARIATION RATES Absolute values (%)	
	Backward Linkages	Forward Linkages	Backward Linkages	Forward Linkages	Backward Linkages	Forward Linkages
aAGR	1.097	0.394	1.241	0.433	11,60	8,94
aFOR	1.075	0.352	1.285	0.436	16,40	19,16
aOPP	1.035	0.204	0.216	0.216	378,38	5,89
aFOP	1.125	0.593	1.153	0.792	2,38	25,15
aMAN	1.051	1.247	1.195	1.337	12,03	6,71
aENE	1.083	0.763	0.723	0.592	49,76	28,82
aCNS	1.101	0.378	1.203	0.457	8,48	17,27
aTTR	1.112	1.276	1.135	1.097	2,03	16,36
aHOT	1.098	0.374	1.175	0.484	6,56	22,73
aSERV	1.060	1.994	1.155	1.732	8,28	15,12

Source: Own elaboration.

Table 28 - Key sectors for Lüneburg. Expert procedure vs. Automatic procedure.

	EXPERT PROCEDURE		AUTOMATIC PROCEDURE		VARIATION RATES Absolute values (%)	
	Backward Linkages	Forward Linkages	Backward Linkages	Forward Linkages	Backward Linkages	Forward Linkages
aAGR	1.081	0.463	1.152	0.575	6,17	19,55
aFOR	1.057	0.374	1.206	0.392	12,37	4,46
aOPP	1.090	0.203	0.969	0.255	12,51	20,15
aFOP	1.151	0.524	1.159	0.631	0,69	17,01
aMAN	1.110	0.939	1.035	1.047	7,23	10,37
aENE	1.128	0.620	1.004	0.405	12,29	52,90
aCNS	1.115	0.402	1.079	0.450	3,26	10,61
aTTR	1.117	1.327	1.098	1.182	1,73	12,25
aHOT	1.114	0.391	1.114	0.528	0,00	25,91
aSERV	1.058	2.472	1.102	1.930	3,93	28,07

Source: Own elaboration.

Table 26 displays the BL and FL for Huesca with the different procedures. We can outline that the most important sectors of Huesca with expert procedure are: aMAN, aTTR and aSERV, aAGRI and aCNS. With an automatic procedure, three of the most important sectors are the same (aMAN, aTTR and aSERV).

Table 27 displays the BL and FL for Konstanz with two different procedures. So, we can see that the most important sectors of Konstanz with expert procedure are the same for Konstanz with automatic procedure: aMAN, aTTR, and aSERV.

Table 28 displays the BL and FL for Lüneburg with the two different procedures. Again, the most important sectors of Lüneburg with expert procedure are the same for Lüneburg with automatic procedure: aMA), aTTR, and aSERV. No significant changes are found in the second and third region for the comparison of procedures.

In all tables, we calculate a percentage change to analyse the differences between procedures. We can see that in the case of Huesca the highest differences in forward linkages are in the sector aCONS and aENE in Konstanz and Lüneburg, and the lowest values for Konstanz and Lüneburg are obtained in aFOR while in Konstanz is aOPP. In the case of backward linkages the highest values are in sectors like aENE for Huesca, aOPP for Konstanz and Lüneburg and the lowest values are obtained in aOPP for Huesca, in aTTR for Konstanz and aHOT for Lüneburg.

4.3.2 Le Masné Index

In order to analyse changes in technical coefficients, the first idea is to measure some indicators of statistical distances between the I/O or SAM tables. When pairs of Input-Output or SAM tables are compared, it is possible to compute the Le Masné Index (Le Masné, 1990) for the sector *j*:

$$S_j = 100*(1 - 0.5 \text{ sum }_i |a_{ij} A - a_{ij} S|) \qquad (6)$$

The Le Masné Index will be close to 100 in cases of high similarity, and is therefore one of the many statistical distance indicators that can be analysed for the purpose of studying the similarity between tables. In Table 43 we present Le Masné index for Huesca, Konstanz and Lüneburg for analysing the similarities between a SAM built with an automatic procedure and a SAM built with an expert procedure.

Table 29 - Le Masné Index. Automatic procedure vs. Expert procedure.

		Huesca	Konstanz	Lüneburg
1	aAGR	95.85	88.11	90.90
2	aFOR	91.14	94.87	90.64
3	aOPP	83.43	91.05	99.52
4	aFOP	95.10	97.97	91.80
5	aMAN	98.48	95.23	89.20
6	aENE	90.82	91.83	80.40
7	aCNS	86.06	94.73	96.13
8	aTTR	88.60	87.19	90.62
9	aHOT	88.58	92.94	98.54
10	aSERV	88.27	83.90	86.42
	AVERAGE	**90.63**	**91.78**	**91.42**
11	cAGR	49.86	98.81	93.04
12	cFOR	99.56	97.63	97.34
13	cOPP	96.98	80.53	99.79
14	cFOP	86.78	98.43	95.16
15	cMAN	80.88	91.37	71.15
16	cENE	81.45	51.97	67.34
17	cCNS	78.20	99.61	97.25
18	cTTR	69.18	95.43	95.90
19	cHOT	96.59	99.32	98.25
20	cSERV	51.21	56.55	72.09

	AVERAGE	**79.07**	**86.96**	**88.73**
21	LABOR	99.64	61.38	61.72
22	CAPITAL	61.82	70.44	86.75
23	LAND	81.77	82.53	88.93
24	HOUS	80.70	65.58	64.56
25	TAX_LESS_SUB	89.74	86.75	77.30
26	GOV	84.95	88.11	82.57
27	INV	94.86	96.40	97.00
28	ROW	54.85	32.53	57.36
	TOTAL AVERAGE	**83.76**	**84.68**	**86.34**

Source: Own elaboration.

Table 27 displays the Le Masné index for Huesca, Konstanz and Lüneburg. We can point out that the total average similarity between procedures is 83.76% for Huesca, 84.68% for Konstanz and 86.34% for Lüneburg. In the case of average for activities, we get 90.63% for Huesca, 91.78% for Konstanz and 91.42% for Lüneburg. The similarity is higher than average for commodities: 79.07% for Huesca, 86.96% for Konstanz and 88.73% for Lüneburg. There is a high degree of similarity in the majority of accounts, being higher in Lüneburg and smaller in Huesca. However, the case of Huesca is slightly different for and the similarity indicator is the lowest. This may be due to the specific characteristics in the construction and later updating of this database. The SAM NUTS 3 of Huesca has been constructed with specific data which was available in regional statistical accounts, while the two others NUTS3 are ultimately deriving from the German national accounts.

4.3.3 Including the rural-urban split

In this section we present a case study to compare Konstanz with the rural-urban split produced with an expert as well as an automatic procedure. The structure of rural/urban SAM of Konstanz is presented in Table 30.

Table 30 - Structure of Rural/Urban Konstanz SAM.

aAGR_R	Agriculture_Rural	aSERV_U	Servicies_Urban
aAGR_U	Agriculture_Urban	cAGR	Agriculture
aFOR_R	Forestry_Rural	cFOR	Forestry
aFOR_U	Forestry_Urban	cOPP	Other primary production
aOPP_R	Other primary production_Rural	cFOP	Food processing
aOPP_U	Other primary production_Urban	cMAN	Other manufacturing
aFOP_R	Food processing_Rural	cENE	Energy products
aFOP_U	Food processing_Urban	cCNS	Construction
aMAN_R	Other manufacturing_Rural	cTTR	Trade and Transport
aMAN_U	Other manufacturing_Urban	cHOT	Hotels and Restaurants
aENE_R	Energy products_Rural	cSERV	Servicies
aENE_U	Energy products_Urban	LABOR	Labour
aCNS_R	Construction_Rural	CAPITAL	Capital
aCNS_U	Construction_Urban	LAND	Land
aTTR_R	Trade and Transport_Rural	HOUS	Households
aTTR_U	Trade and Transport_Urban	TAX_LESS_SUB	Tax less subsidies
aHOT_R	Hotels and Restaurants_Rural	GOV	Government
aHOT_U	Hotels and Restaurants_Urban	INV	Investment
aSERV_R	Servicies_Rural	ROW	Rest of the world
aSERV_U	Servicies_Urban		

Source: Own elaboration.

- Key sector

Table 31 - Key sectors for Konstanz Rural/Urban. Expert procedure vs. Automatic procedure.

	EXPERT PROCEDURE		AUTOMATIC PROCEDURE		VARIATION RATES Absolute values (%)	
	Backward Linkages	Forward Linkages	Backward Linkages	Forward Linkages	Backward Linkages	Forward Linkages
aAGR_R	1.071	0.363	1.224	0.404	12.50	10.26
aAGR_U	1.071	0.238	1.224	0.292	12.50	18.57
aFOR_R	1.049	0.309	1.268	0.385	17.25	19.62
aFOR_U	1.049	0.216	1.268	0.284	17.25	24.02
aOPP_R	1.011	0.194	0.213	0.213	373.50	9.30
aOPP_U	1.011	0.168	0.213	0.213	373.50	21.22
aFOP_R	1.098	0.560	1.137	0.748	3.38	25.05
aFOP_U	1.098	0.319	1.137	0.433	3.38	26.36
aMAN_R	1.026	1.243	1.178	1.326	12.93	6.20
aMAN_U	1.026	0.600	1.178	0.671	12.93	10.57
aENE_R	1.057	0.738	0.713	0.557	48.23	32.59
aENE_U	1.057	0.392	0.713	0.355	48.23	10.57
aCNS_R	1.074	0.332	1.186	0.402	9.41	17.37
aCNS_U	1.074	0.225	1.186	0.291	9.41	22.63
aTTR_R	1.085	1.253	1.119	1.069	3.03	17.20
aTTR_U	1.085	0.604	1.119	0.565	3.03	6.81
aHOT_R	1.071	0.328	1.158	0.432	7.51	23.97
aHOT_U	1.071	0.224	1.158	0.303	7.51	26.28
aSERV_R	1.034	1.986	1.139	1.722	9.22	15.34
aSERV_U	1.034	0.905	1.139	0.834	9.22	8.57

Source: Own elaboration.

Table 31 shows the Rural/Urban BL and FL for Konstanz under the two different procedures. We can outline that the most important sectors of Konstanz with expert procedure are: aMAN_R, aTTR_R and aSERV_R. With an automatic procedure, three of the most important sectors are the same (aMAN, aTTR and aSERV).

Additionally, we have calculated a percentage change to illustrate the differences between procedures. We can see that in the case of Konstanz the highest differences in backward linkages are in the sector aOPP_R and aOPP_U, and the lowest values for Konstanz is obtained in aTTR_R and aTTR_U. In the case of forward linkages the highest values are in sector aENE_R and the lowest values are obtained in aMAN_R.

- Le Masné Index

Table 32 - Le Masné Index. Automatic procedure vs. Expert procedure Konstanz Rural/Urban.

		Konstanz
1	aAGR_R	91.58
2	aAGR_U	96.54
3	aFOR_R	96.36
4	aFOR_U	98.51
5	aOPP_R	93.66
6	aOPP_U	97.39
7	aFOP_R	98.56
8	aFOP_U	99.41
9	aMAN_R	96.62
10	aMAN_U	98.61
11	aENE_R	94.21
12	aENE_U	97.62
13	aCNS_R	96.26
14	aCNS_U	98.46
15	aTTR_R	90.92
16	aTTR_U	96.27
17	aHOT_R	95.00
18	aHOT_U	97.94
19	aSERV_R	88.59
20	aSERV_U	95.31
	AVERAGE	**95.89**
21	cAGR	97.78
22	cFOR	95.17
23	cOPP	60.71
24	cFOP	95.68
25	cMAN	90.27
26	cENE	37.22
27	cCNS	98.89
28	cTTR	87.70
29	cHOT	99.09
30	cSERV	57.62
	AVERAGE	**82.01**
31	LABOR	23.11

32	CAPITAL	41.18
33	LAND	87.31
34	HOUS	65.58
35	TAX_LESS_SUB	70.55
36	GOV	88.11
37	INV	96.40
38	ROW	32.53
	TOTAL AVERAGE	**85.33**

Source: Own elaboration.

Table 32 shows the Le Masné index for rural/urban Konstanz. The total average similarity between procedures is 85.33%. In the case of average for activities (95.89%) the similarity is higher than average for commodities (82.01%). We can observe a high degree of similarity in the majority of accounts. If we compare this procedure with the rural/urban split and the procedure without split, we can observe that we obtain a slightly higher degree of similarity between accounts in the first case.

5 Conclusions

In this report we have constructed 12 SAMs for a selection of NUTS3 regions within the EU. As a novelty, the EURO method has been used as a method for regionalisation. The first result of the research undertaken has been the production of these 12 expert SAMs that can be used for further policy simulations using, for example, the RURAL ECMOD CGE-based approach.

The SAMs have been analysed in detail, applying different techniques for the structural description of regional economies such as key-sector analysis or structural path analysis. For illustrative purposes, we have run some simple policy simulations using a linear CGE model. With respect to the accuracy of these databases, a multiplier analysis has been developed as well as a landscapes study and results seem reasonable. As an example, in the case of Huesca, results point out as key sectors *Large farms arable crops (Rural)*, *Food Industries (Rural)*, *Construction (Rural)* and *Other private services (Rural)*. This is consistent with the economy of a region with a unique urban core (Huesca) as the provincial capital that maintains a public service based activity. In the population areas that surround it, mainly rural, the agricultural and food processing activities sustain the SAMs, where the economy of the area as well as construction companies that carry out business throughout the area, are concentrated. The provision of services to the population is also located in these rural communities.

One of the conclusions of this work is that there exist at national level a huge amount of information, not always easy to gather, which allows to develop expert SAMs of quality, including with a rural-urban split, However, such information is time consuming to gather and there seems to be no possibility to compile quickly a large number of SAMs of this kind. Given the huge data involved, its interpretation is not always easy: we have interpreted the databases and policy shocks using the clusters defined in Raggi et al. (2013), trying to detect similarities or differences within the cluster environment. The counterfactual analysis has been proposed consisting of assessing the effect of the removal of CAP funding and looking for levels of dependency from this source of income in the different regions. The results show a range of impacts with a tendency to show that regions depending more on agriculture and lower GDP and accessibility would be more significantly hit by the deletion of CAP than regions, even rural, with higher GDP or accessibility. It is still difficult to make general conclusions between clusters and more work is definitely needed here both in terms of validation of the SAMs, analysis of their contents through purely linear models as carried out in the present work or, still to be done, more elaborated CGE models.

Once the expert SAMs were constructed, we have developed a more automatic approach with less data requirements and compared the automatic SAMs with those obtained with the experts approach. This second automatic approach has implied a new approximation to the regions starting from NUTS2 SAMs and dealing with the minimum homogeneous information available.

Finally, a comparison of the results has been undertaken under the two different approaches for three study cases. A significant battery of results has been outlined, which may be useful in future research on the one hand for the methodological novelties proposed and on the other hand for its utility in more applied research and policy evaluation projects. In short, if the automatic procedure produces consistent SAMs, we can imagine possible relatively easily the production of hundreds of NUTS3 SAMs.

A structural analysis has been proposed for a better interpretation of results from these 'automatic' SAMs, and the analysis seems to be in line with the ones obtained from the more elaborated procedure in most cases. We can observe that with an automatic procedure, it would be possible to have an initial approach to the regional economies´ main behaviours. This is the conclusion we can derive after calculating a similarity index such as the Le Masné Index which stands higher than 80% for the three case studies. This result seems to be a reasonable value for not discarding this simple procedure as a basic approximation to the main features of an economy when data available are very scarce. But we should not forget that this first approach does not provide the refinements and accuracy that a non-automatic procedure can offer, especially if, as it may be the case, we are interested in policy simulation where the better the database is, the closer to reality the policy results are.

As a conclusion of this research, we suggest that the automatic procedure can be reliable for an initial perspective of regional economies when data is missing. This first step can be helpful for assessing simple shocks or for aggregate policy simulations. But we encourage the importance of a deeper statistical fieldwork in a second step as well, that would combine this line of research with SAMs at a more disaggregated level if we are interested in specific shocks that might provide more reflexive conclusions both in ex-ante and ex-post policy simulations.

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